ENGINEERING NEWS

As briefly announced in our last week's issue, "a gigantic syndicate" whose object is to tunnel the Detroit river, known as the Michigan & Canada Tunnel Company, and representing more than $100,000,000 of capital has been legally formed in Canada, and will be properly qualified for transacting business under the Michigan State laws at once. This syndicate is composed of D. O. MILLS, New York, GEORGE BLISS, of Morton, Bliss & Co., N. Y.; Mr. LAIDLAW, of the Bank of California; Mr. HAWKS, of the Michigan Central Railroad Company; NICOL KINGSMILL, counsel for the Michigan Central Railroad in Canada; GEORGE LAIDLAW, of Toronto; ANDREW ONDERDONK and JAMES ROSS.

It is with no slight pleasure that we find Chief Engineer HAWKS, of the Michigan Central, figuring in this list of bloated capitalists. We knew him for a good engineer before, and knew he ought to be a capitalist, like every other good engineer, but we did not know before that he had 'got there".

THE various large fire-proof Government buildings in our large cities range in cost from 18 to 45 cts. per cu. ft., a fair average for fire-proof brick and iron and terra cotta being some 30 cts., all iron buildings perhaps a cent or two more, all depending greatly on the amount of the entire work.

Mr. ARTHUR KIRK has prepared a circular advocating the construction of a ship canal from Pittsburgh to Lake Erie. He proposes to use the Allegheny river up to Franklin, 123 miles from Pittsburg, and from there to build a new canal by way of the Venango river and the bed of the old Rochester and Erie canal.

At present the cost of freight on a ton of pig iron sold for $14 to $18 is $9.60, distributed as follows: Ore from mines to lake, $1; loading, 5 cts.; freight on lakes, $1.70; unloading, 5 cts.; port charges, 25 cts.; loading on cars, 5 cts.; freight to Pittsburg, $1.50; a total of $4.60 per ton of ore. As 1.6 tons of ore are used per ton of pig, the cost of freight on ore per ton of pig is $7.36. The freight on limestone is 53 cts., on coke, 70 cts., and on the pig itself to the foundries, $1.01, making the total cost in freights, $9.60 per ton of pig.

If the proposed waterway were constructed, the freight would be: Ore from mines, $1; loading, 5 cts.; from lakes to Pittsburg, by canal, $2; coke, by canal, 12 cts.; pig iron, by canal, 6 cts.; a total of $4.53 per ton of pig and, consequently, a saving of $5.07 per ton. At this rate the saving on 2,000,000 tons of pig would be $10,000,000, or the improvement would pay for itself in one year.

THE provision for the Hennepin canal contained in the River and Harbor bill reported to the Senate, May 21, is that the Secretary of War be authorized and directed to have suitable plans made for a navigable waterway not less than 14 ft. deep between La Salle and Lockport and Lake Michigan suitable for navigation and capable of carrying not less than 60,000 cu. ft. of water per minute flowing at the rate of two miles per hour, and for a canal from Hennepin on the Illinois river to the Mississippi at a point near the mouth of the Rock river, to have a depth of not less than 7 ft. of water, and to be 80 ft. wide at the water line, with locks 170 ft. long, and 30 ft. wide. These surveys and plans are to be paid for out of the appropriations for the Hennepin canal and the improvement of the Illinois river.

DAMMING the headwaters of the Missouri and Yellowstone rivers in the canons of the Rocky Mountains, and the upper tributaries of the Mississippi is recommended by Maj. POWELL, of the Geological Survey, on the ground that the navigation of these rivers would be improved; that the floods would be sufficiently checked to save the lower river bottoms from overflow and then the lowlands improved, and that the water stored in these reservoirs could be used for irrigation and thus millions of acres of arid land be reclaimed and made more productive than the same area in the Middle States, which depends upon uncertain rainfall. The Government is only asked to furnish $250,000 to begin the work. After the dams are built, private capital will take care of the irrigation. The supporters of the scheme claim that it has been tried on a smaller scale in California, Utah and Colorado with never failing success, and that nothing is wanting but the necessary appropriation to insure the success of the project.

THE message of the Governor of Louisiana says that the State has, in the past two years, awarded 118 contracts for levee work involving the construction of 69 miles of new levee, and the raising of 49¼ miles of old. The total amount of earthwork was 3,372,828 cu. yds., and at the average price 18½ cts. per cu. yd., the total cost is a little more than $600,000. The aggregate work done by the State and the various local levee boards is 90 miles of new levee, and 76½ miles of old levee raised and enlarged, the total earthwork being 5,684,126 cu. yds. and the cost about $1,163,000. In addition to this the Mississippi River Commission, in consideration of work done by the State of Louisiana in Arkansas, enlarged 20 miles of old levee and constructed 17 miles of new, the earthwork amounting to 1,500,000 cu. yds., and the cost being $320,000. This work should give before the next high water season a continuous line of levees from the Highlands south of the Arkansas river to the upper limits of Louisiana. The Chief Engineer, Mr. RICHARDSON, and his assistants, are very highly commended by the Governor.

THE most serious railway accident of the week was a collision, May 28, between a freight train and a light engine on the Atlantic & Pacific Railroad near Walnut Station, 54 miles east of Flagstaff, Ariz. One man was killed and 3 were seriously injured.

During the week there have been heavy storms in the West and Northwest. Very extensive damage was done in Nebraska and Missouri, and several washouts occurred. Heavy rainstorms have also been experienced in the Middle and Atlantic States.——A waterspout occurred at Chadron, Neb. May 26——A cyclone struck Wellsville, N.Y., May 28, and did considerable damage.

THE following bridge accidents are reported: On May 23, the highway bridge at Lake Side, near Medina, N. Y., gave way while being repaired; 3 men, with a team and wagon load of hay were thrown into the water, but were rescued.——On May 28, 3 spans of the bridge across the Muskingum river at Gaysport, O., were blown down. The bridge was completed last November at a cost of $40,000. The three spans wrecked were each 140 ft. long and cost $7,350.——The recent heavy rainstorms, noted above have caused the loss of a number of bridges. Near Mountain Bay, Ark., a long stretch of trestle work was washed out. All the bridges in South and North St. Joseph, Mo., were destroyed, as well as all the wagon bridges in Buchanan Co., Mo. A number of bridges across the White and Lone Tree rivers, in Nebraska, were washed away.

THE cause of the derailment of the Shore Line express on the South Norwalk draw-bridge, May 18, was, as mentioned in our issue of May 26, the device for connecting the rails on the draw and on the approach. To avoid the jar incident to the use of butt-joints with so large a space between the ends as is necessary with a draw bridge, a mitred joint was introduced by Vice President Reid. The rails of the draw are tapered and fit against the sides of correspondingly tapered rails of the approaches, making a smooth riding joint. The rails on the draw have to be lifted a few inches when it is opened so as to clear the ends of the fixed rails, and when the draw is closed these rails fall into position and are held there by their own weight. There is nothing to pull these rails down or hold them in place, and it is quite possible for one rail to catch on another instead of falling into position. It is the duty of the draw tender to inspect this joint every time the draw is swung, and it is thought that in this case he neglected to do so.

RAILWAY accidents in the United Kingdom for 1887, as reported to the Board of Trade, were 33 persons killed and 647 injured, as against 12 killed and 606 injured in 1886. There were 31 collisions between passing trains, by which 25 persons were killed, and 244 passengers and 14 servants were injured, and 42 collisions between passenger trains and goods and mineral trains, by which one servant was killed, and 6 cattle drivers and 24 servants were injured. Two cases are mentioned of trains coming in contact with projections, 58 cases of trains leaving the line, two cases of trains traveling in the wrong direction, 23 cases of trains running into stations or sidings at too high a speed, and 116 instances of trains running over cattle or other obstructions.

The Pennsylvania has issued instructions to stop all new work which has been mapped out on lines west of Pittsburg. The double track work on the Pan Handle division between Columbus and Pittsburg has been stopped and the appropriation of $150,000 for new shops at Columbus and Dennison has been canceled. The entire equipment programme for the entire system west has been cut down, and instead of building 54 locomotives as proposed at the first of the year, but 33 will be constructed. This is all on account of the letting up in traffic, which, it is alleged, shows no indication of improving.

CHICAGO does not seem to be making much progress towards elevated railways. According to the latest reports the late attempt to float a loan has been a failure, and all the company now owns is an ordinance from the aldermen allowing its construction on condition that the ground over which it passes is paid for. To gain a right of way the company must buy about 25 ft. off the rear of stores, churches, hotels and various other buildings, and the loan was put on the market before even an attempt was made to purchase them. Few people in Chicago believe that the project will materialize for some time to come.

THE projected Elm St. improvement has been again revived, since the failure of the Mayor's bill for building an underground line through it for the city; and the same inchoate company which was announced as ready to build the line last year, now again proposes, if reports are true, to build the line if permitted and pay half the cost of the Elm St. improvement for the privilege of doing so. The proposed route is to Union Square, thence under the blocks to Madison Square, and up Madison Ave. to Harlem, with a branch to the Grand Central station, enabling mail cars to be run to and from the Post Office direct. The estimated cost of the street improvement proper is $2,500,000.

DUNCAN'S, "Tramway Manual", an English publication, gives the following summary of the street railways in England for 1887:—Capital authorised, $89,515,000; expended, $65,620,000; miles open for traffic, 886; horses, 25,501; engines, 484; cars, 3,494; passengers carried, 416,518,423; gross receipts, $14,011,620 net receipts, $3,299,610. The working expenses are about 75.5 per cent. of the gross receipts, and the earnings are equal to about 5¼ per cent. on the capital expended. On the railways the working expenses are 52 per cent. of the gross receipts, and the net earnings are equal to 3.99 per cent. on the capital expended. The average cost per mile of railway is $214,340, while for the street railways the cost is $74,135.

As a good example of how the money goes it is claimed that the Dominion of Canada awarded a contract to build a bridge over the Fraser river, on the Canadian Pacific, to Contractor ONDERDONK, at $1,500,000, who sublet the work to a Philadelphia firm for $400,000, which, in turn, let the job to another contractor for $100,000, who let it for $75,000, at which figure the bridge was built. We do not vouch for the truth of this remarkable report, but it has a kind of natural sound as one reads it.

THE model of the new steamship which, according to Sir WILLIAM PIERCE, Chairman of the Guion Steamship Co., is to make the trip from Queenstown to New York in five days, is now on exhibition at the Glasgow Exhibition, and bears this inscription: "Designed by the Fairfield Shipbuilding and Engineering Co. for the Guion Steamship Co., Limited. Length, 560 ft.; breadth, 63 ft.; depth, 52 ft.; tonnage, 11,500; passage Queenstown to New York, five days."

The Fort Madison Bridge Across the Mississippi River.

BY W. W. CURTIS, RES. ENG.

The located line of the Chicago, Santa Fé & California Railway (the Chicago extension of the Atchison, Topeka & Santa Fé Railroad) crosses the Mississippi river at the city of Fort Madison, Iowa.

A charter for a bridge at this point had been obtained in 1872 by a few of the citizens, who were interested in a proposed road, starting from Peoria, Ill. Owing to the panic of '73, however, the road was never built and the charter remained unused until the extension of the Santa Fé was determined upon in 1887, when it was surrenderered to its present owners. In transferring their rights however, the holders of the charter inserted a proviso that the structure should be both a railroad and wagon bridge. Surveys for the bridge were first made in 1883 in connection with the preliminary surveys for the road, and a general design was prepared; but in the beginning of 1887 the entire matter of a crossing was placed by Mr. A. A. ROBINSON, Chief Engineer of the proposed extension, in the hands of Mr. O. CHANUTE, as Engineer. Under his direction a new line was located, further up the river, securing a more direct approach for boats, and much decreased length of iron work.

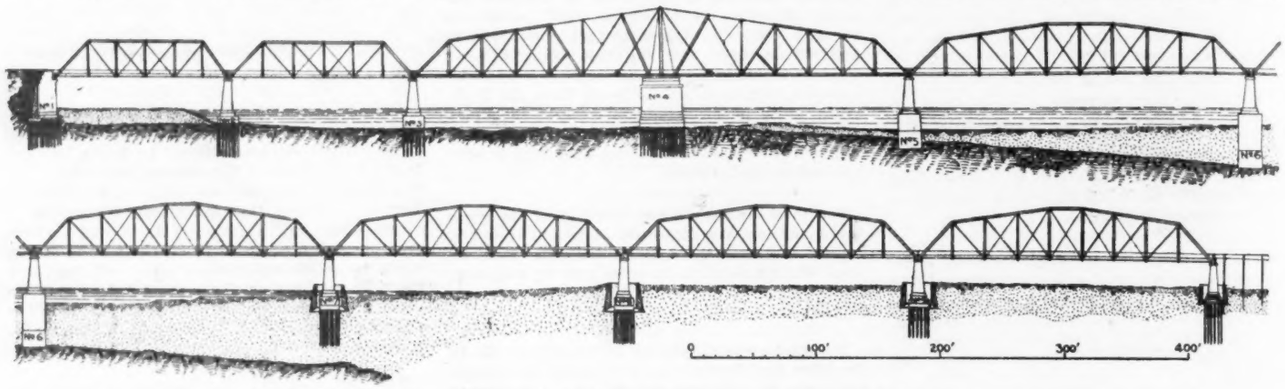


Fig. 1. General Elevation, Ft. Madison Bridge. OCTAVE CHANTTLE, Engineer.

GENERAL DESCRIPTION.

The topography of the river at this point is similar to the general type of the upper Mississippi. The river, studded with islands in all stages of development from the mere towhead, bare only at extreme low water, to thickly wooded tracts covering many acres, winds from one side to the other of a valley several hundred feet deep, and of a width varying from one half mile to several miles. At Fort Madison, this valley is about two miles wide, the immediate banks being rather low and sloping very gradually back to the abrupt sides of the hills.

Authority is given under the charter to build either a high or low bridge, but if the former, the height above high water must not be less than 50 ft. Such a height being impracticable here, it was necessary to make the crossing a low one, the Congressional requirements of which are clear openings of draw of 160 ft. and at least one raft span of 250 ft.

Figure 1 shows the elevation and Figure 2 the profile of the bridge. The flood range of the Mississippi in this part of its course, is about 16 ft. between high and low water. On account of the low stage of water during the past season, no opportunity has been given to measure the actual velocity acquired at the highest stage of the river; it is probably from four to five miles per hour; being about two miles per hour, at the ordinary boating stage.

There is no appearance of rock in the present channel of the river. The limestone ledges crop out all along the Illinois bluffs, and rock is found within 10 ft. of low water in the slough on that side but it is there broken off abruptly, and borings at pier 8, 130 ft. below low water, failed to find anything but sand and gravel. A good substitute for rock, however, is a very solid blue clay found on the Iowa side of the river.

In view of these facts, it was decided to use pile foundations for the first four piers, to be cut off just above the clay; pneumatic caissons for piers 5 and 6 reaching 6 ft. and 2 ft. respectively into the clay, which is here overlaid by a considerable bed of gravel; and piles cut off some 12 ft. below the river bed, by the aid of bottomless cribs, for piers 7 and 8, 9 and 10.

From pier 10, a pile bridge carries the railroad and roadway across the sand bar. It is built with from four to ten piles in each bent. Upon the exposed portion of this approach a 12×12-in. stick set at an angle of 45°, and securely braced and bolted to piles and armed with an iron rail, acts as an ice breaker for such cakes as may get over or around the stone dike, which forms a part of the bridge work.

This dike 650 ft. long and with its top 9 ft. above low water, running from the wooded part of Doerr's Island well out into the river, has been built to protect the pile approach from the ice, which here comes down with great force. In consequence of the great widening out of the river just above the bridge site, the ice when it first starts moves down in a large body or field generally from 12 to 20 ins. thick, and as it reaches the contracted opening selected for the bridge site, it gorges, piles up at the sides on the shores and thus breaks up into smaller fragments of such size as to squeeze through the narrow passage. The dike is expected to assist this breaking up by producing a local jam above the bridge, which will break up the ice into cakes of such size as may pass through the openings without inflicting damage, and also, incidentally to cause an increase in the height of the sand bar, by deposit under the pile approach.

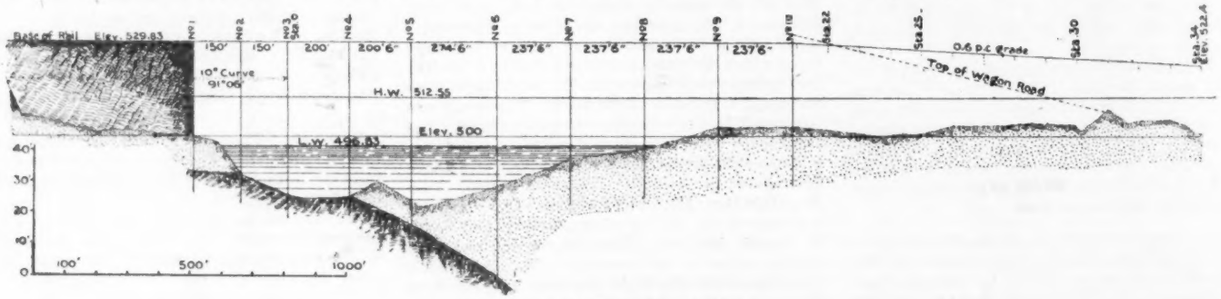


Fig. 2. Profile, Ft. Madison Bridge.

SUBSTRUCTURE.

The general arrangement of the masonry supports is shown upon the plan and profile. The abutment on the Iowa side is provided with wing walls and rests upon piles driven in the clay and cut off inside of a coffer dam 8 ft. below the water and from 2 ft. to 4 ft. below the surface of the clay. A course of 12×12-in. caps and 12-ins. of grillage, with concrete rammed around the pile heads and between the caps, completes the foundation.

Piers 2, 3 and 4 are on piles cut off as close to the bed of the river as it was possible to saw, say 6 to 18 ins. These piles were driven partly with an automatic steam hammer (Nasmyth), weighing 3,600 lbs., the iron frame of which weighed as much more; and partly with a 3,200-lbs. steam drop hammer, using an iron follower, weighing 1,000 lbs. The piles were driven until the movement was but about ⅛ in. for the automatic hammer, falling 3 ins. or about 1½ in. with the drop hammer falling 20 ft. At these rates the bearing value of the piles would be by WEISBACH's formula, 210 and 132 tons respectively. The actual maximum loading per pile is 19 tons.

The use of iron followers for drop hammers is deserving of more consideration than is usually given it. The experience of the writer is that while there is no noticeable loss of power, there is a considerable saving in piling and increase in accuracy of driving. The follower holds the pile firmly in place and prevents splitting.

The construction of the pivot pier, No. 4, is shown more in detail in Fig. 3. The grillage is 4 ft. 3 ins. thick, the upper 15 ins. being dressed to an accurate circle of the desired diameter. The coffer dam was footed against these two courses and was formed of 3 ins.×8 ins. pine plank staves, dressed on the sides to a slight bevel, around which were placed seven wrought-iron hoops 4 ins.×$\frac{3}{16}$ in., 5 ins.×$\frac{3}{16}$ in. and 6 ins.×$\frac{3}{16}$ in., similar to those used for water tanks, and screwed up tight. Inside of these circular braces of plank were fitted. As a water pressure of 19 ft. was to be resisted, additional security against leakage was obtained by placing a string of candle wicking vertically between each stave. When the caisson was submerged to about full depth it became necessary for the steamboat to assist it into final position. A 12 ins.×12 ins. post was bedded in the concrete in the center of the pier, with four braces running to the circular bracing of the sides. This makes a very cheap coffer dam, and was found to work well. The construction of the draw protection is explained by the drawing. The piles were 55 ft. long, of white oak and cypress.

The ice-breaker of the draw protection was built up 3 or 4 ft. high on launching ways, then launched, towed into approximate position and built up until its height was 4 ft. less than the depth of water.

After having then been accurately located, railroad iron, sufficient to sink it, was piled upon it and the piles driven inside by the floating driver. Removing the iron, the crib floated and framing was recommenced.

Such a procedure would, of course, be ridiculous if working on the ice or in still water, but in a strong current, with over 20 ft. of water, it would have been extremely difficult to have driven the piles in as favorable positions to resist the displacement of the structure by ice, and then build and sink a well braced frame around them; some of the piles would probably be found sufficiently out of place to have prevented its correct location.

For the assistance of rafts through the draw opening, a sheer boom 1,000 ft. long, extends up the river from the nose of pier 3, making an angle with the longitudinal axis of the pier of 4° to the north; thus widening the entrance to the draw, and enabling rafts to slide through, rubbing against the boom.

The pneumatic caisson, piers 5 and 6, while being good examples of similar constructions contain no especially novel features. Their size at the cutting edge was 54 ft. 2 ins. × 20 ft. 2 ins.; the walls were of two thicknesses of 12-in. timber with 3 courses of 3-in. plank outside and 1 course inside, built with a batter of ¼ in. to the foot and well braced inside.

The roof was 6 ft. 6 ins. thick of solid timber, laid in grout. The walls of the crib above this were 15 ins. thick, well braced together. The space inside the crib was filled with concrete, mixed in the proportion of cement 1, sand 2, stone 3 to 4, with as many large stone in addition as could be well bedded therein.

The working chamber of No. 5 was entirely filled with concrete, made as for the other work, except that used immediately under the shoe, where instead of broken stone, coarse screenings were mixed with the mortar. In No. 6, the working chamber was concreted up to the top of the lower chord, with the remainder of the space filled with sand thoroughly wet and packed.

TO BE CONTINUED.

Proposed Detroit River Tunnel.

The scheme for tunneling the Detroit river, at Detroit, is, according to Mr. J. D. HAWKS, Chief Engineer of the Michigan Central Railway, in a fair way to be pushed. The tunnel is not an assured thing, but either a tunnel or a bridge will have to be built soon if the Michigan Central wants to retain its business. Estimates of cost are withheld, but a single track tunnel, which, it is alleged, will answer all requirements for the present, would in the end be cheaper than the ferry system and without its dangers and delays. On a single track 5,000 cars could be run through daily. With the present arrangement passengers have been taken from Windsor at 8 A. M. and not landed at Detroit until 6 P. M.

The tunnel proposed would not be bored beneath the river bed, but would be simply an iron tube on the HALL system, as illustrated in our issue of March 26, 1887, extending from one side of the river to the other. An immense caisson, resembling a railroad snow-plow, is sunk a few feet below the river bed, and within this the first length of tube is constructed and buttressed at the rear end. When the section is finished hydraulic jacks are employed against the end of the tube to move the caisson forward through a trench which has been dredged for its reception. Succeeding sections are laid in the same way. When the tube is all laid it is covered with broken stone to avoid its being injured by dragging anchors. A tunnel through the high ground would be required to reach the bed of the river.

THE Buffalo fire commissioners have "unhesitatingly recommended that the supply of natural gas be entirely cut off from the city", a rather radical recommendation considering that the late difficulty appears to have arisen only from the accidental clogging of an automatic reducing valve. It should surely be possible to insure that the pressure shall never rise above a certain maximum in the pipes, and if this be done all danger of a repetition of the late disaster is averted.

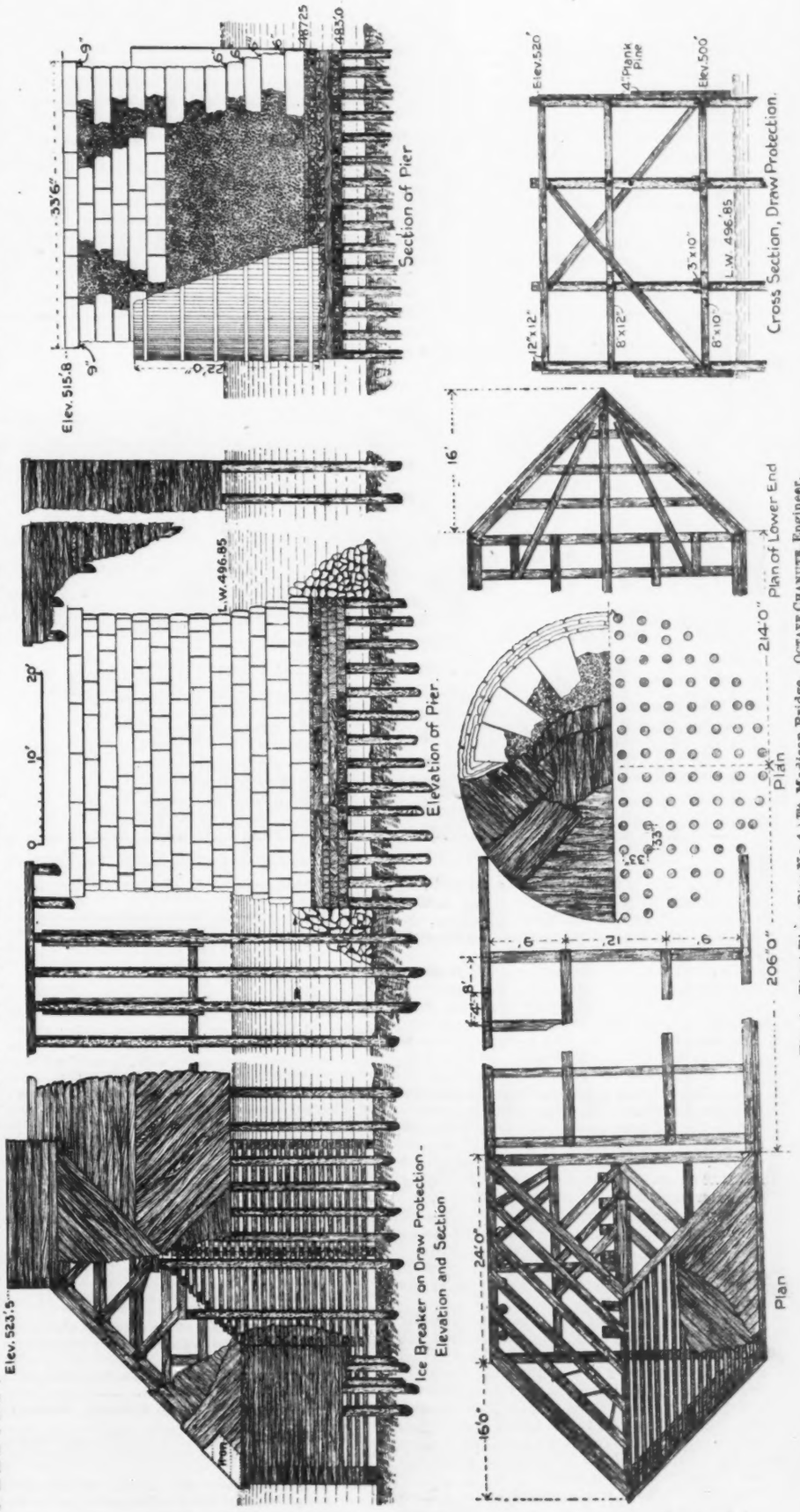
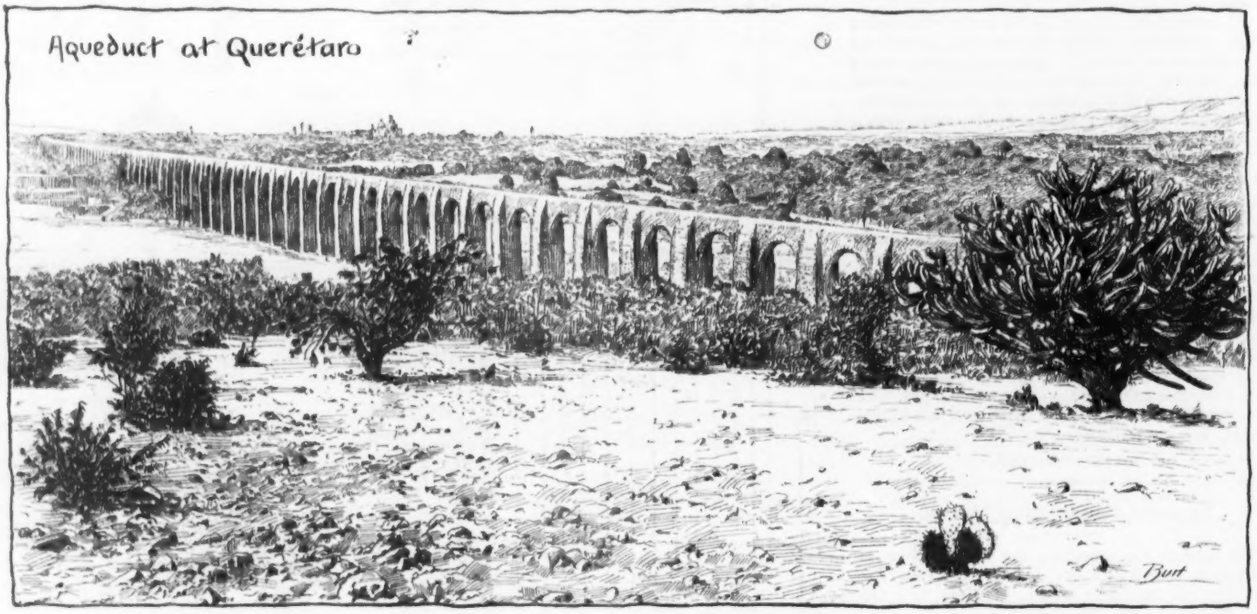


Fig. 3. Pivot Pier, (Pier No 4.) Ft. Madison Bridge. OCTAVE CHANUTE, Engineer.

The Queretaro Aqueduct.

The view we present herewith shows one of the most interesting of the ancient engineering works of Mexico, of which there are a good many scattered about in various parts of the country, including numerous aqueducts of the general nature of that illustrated, but of less magnitude, dams for irrigating purposes, and stone bridges, of all of which there are fine examples in Mexico.

The work illustrated was begun in 1726 and finished nine years later, at a total cost of $131,091, which would be considerably larger at the present time, and no less a sum than $88,287 of this was a donation from its designer and builder, Don JOAQUIN ANTONIO URRUTIA Y AVANA, "Cavalier of the Order of Alcantara, Marquis of the City of Villar del Aquila," a philanthropic nobleman of Spanish birth, but whose life was chiefly passed in Mexico. A statue to his honor stood in the plaza of Queretaro



The Aqueduct at Queretaro, Mexico, built 1726-35.

until 1867, when it was destroyed by the besieging artillery, the Emperor MAXIMILIAN then holding the place, and making his last stand thereat. He was shortly after executed on a low hill near the city.

We regret that we have not been able to obtain full technical details of the work to accompany our view, but can only state that the main part of the aqueduct consists of 74 arches of 15.04 metres (50 ft.) clear span carried on massive piers, narrowing at the top in the peculiar manner shown, and of a maximum height from the surface of about 95 ft. the average height being 75 or 80 ft. The water supply is taken from a remarkable spring distant some 8 kilometers (5 miles) from the city, which supplies naturally some 70 litres per second or over 2,000,000 galls. per day. Two reservoirs, with walls 2½ metres high and 167.2 metres in circumference, hold this supply, the water in them being from 14 to 20 ft. deep, and it is carried thence for some 2¼ miles in seven small pipes of brick and cement to the point where the arches commence. Thence until the water is delivered in the city, or for 2½ miles, the water is carried entirely on arches, the minimum height above the ground being some 35 ft.

The public fountains which receive the water brought into the city by this aqueduct, are 28 in all, scattered in various parts of the city, with a special supply to almost every house (2160 in all) a very unusual feature in Mexico, where the rule is, that the water supply is conducted to large public basins, from which it is carried to the houses in large jars by men and women. To effect this subdivision there are five main channels for delivering the water carried through the city on arches.

Queretaro is one of the important towns of Mexico, but has a population of less than 50,000, and that a work of such magnitude should be undertaken for its water supply is a good evidence that even a hundred years ago Mexico was a more civilized country than we are always ready to admit, since we may be sure that if works of such magnitude were now required to supply an equal amount of water there are few towns which would have the enterprise to undertake them. The Mexican Central Railway passes directly beneath this structure, and a fine view of it is obtained from its trains.

Government Stone Contracts.

The following is from the regular specification of the government architect's office.

CONDITIONS OF BID.

Proposals are to be made on a blank form hereto attached, and must state the sum or rate required to fulfill a contract in accordance with the specifications and drawings; also the time required to complete the contract

With each bid must be sent a certified check for $..... drawn to the order of the Treasurer of the United States, as a guarantee that the bidder will perform the work if the contract be awarded him; and, if the Department so desire, will execute a formal contract within two weeks from the receipt thereof, for the said work, giving a satisfactory bond for the faithful performance of the same.

The checks of the unsuccessful bidders will be returned upon the award of the contract; that of the successful bidder, upon the approval of the formal contract by the Secretary of the Treasury; or upon the satisfactory completion of the work, in case such contract shall not have been required. Should the successful bidder refuse, or fail to execute such contract or bond, his check will be forfeited, and the contract become null, if the Secretary of the Treasury shall so direct.

Proposals will be considered only from parties giving satisfactory references.

The names of the officers of any corporation, or of the members of a firm, submitting a bid must be given in full in the proposal, in addition to the corporation, or the firm, signature.

Generally, payments will be made as the work progresses and in accordance with the terms of the contract, 10 per cent. of the value of the work done—20 per cent. on heating apparatus—being retained until the final acceptance of the work.

Parties obtaining copies of the drawings, etc., must return them within.....days from the date of receipt.

Each proposal must be inclosed in an envelope, sealed and indorsed "Proposal for.....;....." and addressed to the Supervising Architect, Treasury Department.

The Government reserves the right to reject any or all bids, and to waive defects, should it be deemed in its interest to do so.

Each bidder is requested to examine the site, and must assume responsibility for all errors or omissions on account of his failure to do so.

The dimensions given on the drawings are in accordance with the general plans, but as variations may occur, or may have occurred, in construction, the contractor is required to make his measurements at the building, construct his work accordingly, and will be held responsible for any errors in his figures and for the proper fitting of his work.

CONDITIONS OF CONTRACT.

Proposals must include the furnishing of labor and materials—with scaffolding, fixtures, machinery, tools, etc.—necessary for the complete and substantial execution of everything described, shown, or reasonably implied in the specifications and drawings, without any extra charge whatever and to the satisfaction of the supervising architect, whose decisions on all questions pertaining thereto shall be final.

All materials must be the best of their several kinds, and all workmanship of the best quality.

The supervising architect reserves the right to make any alterations in the work without affecting the validity of the contract; the value of such alterations, at market rates, to be taken from or added to the amount to be paid under the contract, but no additional compensation will be allowed unless the price be first agreed upon and the work authorized, in writing, by the supervising architect.

The contractor must lay out his own work correctly, and be responsible for measurements. The contractor must give to the proper authorities all requisite notices, obtain official permits and licenses, and pay all proper fees for the same, and must be responsible for all damage or injury caused to persons and property through his operations.

The supervising architect, or the superintendent, may require the contractor to remove from the premises such of his materials or work as are not in accordance with the specifications, and to substitute, without delay, satisfactory work and materials, the expense attending the same to be borne by the contractor.

All rubbish must be removed and the premises be left broom clean.

If the contractor fail to complete the work within the time specified in the contract, a forfeiture of ..... dollars will be exacted for each day's delay.

SAMPLES.

Each bidder to submit with his bid samples of the stone, brick, cement, sand, marble, tiling, and finished wood he proposes to use, and such other samples as may be required for approval afterwards.

CONCRETE.

The trenches, of dimensions shown on drawings, to be filled with concrete. The concrete to be composed of 5 parts of sound stone, broken to about the size of 2-in. cube, 2 parts of clean sharp sand and 1 part of American hydraulic cement, to be well mixed and laid in layers about 6 ins. thick and gently rammed down. Each layer to be wet before the next is added, and leveled with a skim coat of cement-mortar properly grouted in. Proper provision to be made for the passage of drain-pipes, etc., where necessary, or shown on drawings. Centers for inverted arches, where shown on drawings, to be formed of concrete to suit the line of the extrados of the brick arch.

The floors to be leveled up to within.....inches of

finished floor with cement concrete. The concrete to be filled in to the top of the strips after the wooden strips or porous terra cotta floor-tiles are laid.

Concrete for tiled floors to be leveled up to within 2 ins. of floor-line.

STONE FOOTINGS.

Stone footings to be furnished and set on top of concrete or where shown, in 2 courses, breaking joints, of dimensions shown on drawings.

STONEWORK.

All parts of exterior walls hatched in drawings in full lines to be faced with stone.

Basement, from at least 4 ins. below grade to..... water table, to be.....stone, superstructure to be .....

The steps, platforms, door-sills, ...

Cap and bondstones for interior piers to be of .....

Manhole covers to be of ....

The remaining stone required to be such as may be approved by the supervising architect.

The contractor to fill in blanks of the following table, accompanying the specimens furnished by him to the office of the supervising architect:

Specimens.	Weight by the cubic foot—pounds.	Crushing and tensile strength—pounds.
Granite....	.....	.....
Sandstone..	.....	.....
Limestone..	.....	.....

All stone to be close-grained, of an even color and texture, and to rest in the walls on the natural bed.

The body of the stone facing to be.....

Rock-faced stone to be pitched off true from joint line, projection not to exceed 1½ in.

All belt courses, water-tables, steps, platforms, tops of buttresses, sills, voussoirs, lintels, reveals, trimmings, etc., to be.....cut work if of granite.

All moulded work to be cut sharp and clean, and all carved work to be executed artistically, and be spirited, both according to drawings or models.

The stone ashlar to bond into backing.....ins. ..... ins., alternately, as shown, with frequent through stones.

All beds and joints of stone to be true and out of wind. The underside of steps, platforms, etc., to be pointed off square with the face. Each step to have ½-in. wash, and the platforms ¾-in., or as shown on drawings.

Mullions to have copper dowels, as shown.

The window and door-sills to be bedded at ends only.

Projecting cut-stone work to be properly throated underneath to throw off the water.

All copings, gables, dormers, etc., where flashing is required, to have channel for flashing cut on back, the whole being tied to the brick work with iron cramps and doweled where required.

Finials and apex-stones to be properly doweled.

The capstone for chimneys to be of ..... stone, in one piece, ... ins. thick, perforated for the several flues.

The stone bearing-plates for the ends of the girders and trusses and capstones of basement piers to be set to exact level required, and roughly pointed at bottom bed and sides, but cut fine and accurate on top where iron is to rest on it.

The stone-work to be properly cramped together where necessary, and anchored where required to the brick backing with galvanized-iron anchors ¼ in. by 2 ins. proper length.

The joints of cut-stone work not to exceed ½ in., the bed, ⅞ in., without under-cutting, and to set with lime mortar. The joints of the outer surface to be raked out ¾ in. deep and filled in and pointed with lime, putty, and sand, colored to match the stone.

Centers to be provided and set for all stone arches, and must not be eased or struck until the mortar is thoroughly dry.

The mortar to be composed of two-thirds of clean sharp sand and one-third stone lime, slacked at least two weeks before using.

Holes to be cut through stone for passage of goosenecks.

MOST of the iron ores of Colorado are manganiferous and so no difficulty is experienced in securing the speigeleisen necessary for the manufacture of steel. Most of the low-grade silver mines about Leadville possess inexhaustible quantities of ferrous manganese ore, containing 5 to 20 per cent. manganese, and 10 to 40 per cent. metallic iron together with 2 to 7 oz. of silver to the ton. Much of this class of ore, which upon test was found too low in silver to answer the purpose of iron fluxing with the silver-lead smelter has been sent to the steel works, but the price realized has usually proved too small to admit of the regular extraction of the mineral for sale to the steel works. With proper equipments and large contracts this could, however, be done at a profit.

Concrete Piers for the Red River Bridge, St. Louis & San Francisco R. R.

BY C. D PURDON, M. AM., SOC. C. E.

As the Red river is one of the worst, if not the worst, rivers in the Southwest for sudden floods and large quantities of drift wood, it seems proper to offer some reasons for building piers of concrete instead of masonry cylinder, or iron shells fitted with concrete. This bridge is located at Arthur, 16 miles north of Paris, Texas, on the Paris & Great Northern Railway which is part of the St. Louis & San Francisco Railway. At the time it was built, in the fall of 1886, the nearest railway was the Texas & Pacific at Paris, and the nearest quarry of building stone was 25 miles distant, the stone being of very poor quality.

As there was a quantity of shelly limestone in the Choctaw nation, about 7 miles from the bridge site, which was of excellent quality for concrete, though too rough and hard and badly shaped to use for masonry, it was decided to use iron shells for the piers; in shape rectangular, 6½ ft. × 18 ft. under the coping with semi-circular ends, and a batter of ¼ in. per ft.; these shells after being sunk to rock to be filled with concrete made of broken stone, cement and sand in the usual manner. A contract to that effect was made with the Union Bridge Co. of New York, but before work was commenced Mr. JAMES DUN, chief engineer of the St. Louis & San Francisco Railway, decided to use a wooden frame instead of the iron shell, and to fill this with a mixture of Portland cement, sand, and rough stone in such pieces as could be easily handled by one man; using the limestone from the Choctaw nation, not as in ordinary concrete, but the mortar and stone deposited separately.

These piers were to rest on a bed of concrete made of Louisville cement, sand, and broken stone filled into an open crib sunk to rock, the top of the concrete to be 2 ft. below low water.

The mortar for the neat work of the piers was to be made of Portland cement 1 part, sand 4 parts (experiments having shown that this was more than sufficent to fill all the voids in the sand) mixed with just so much water as would flush on the surface after the mortar was rammed. Into this mortar the rough one-man stone was to be worked.

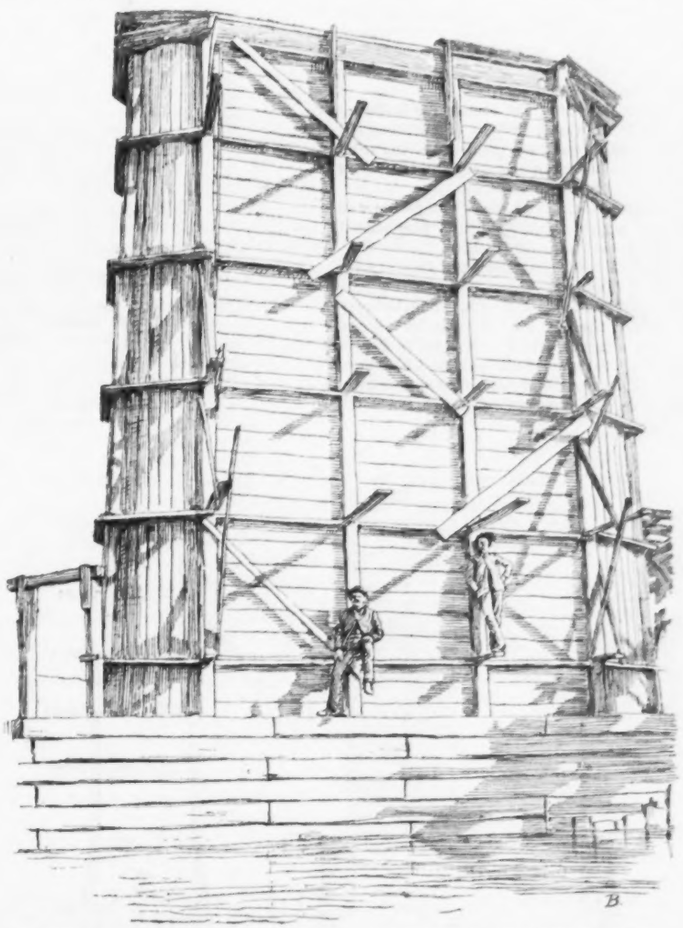
The proportion of water found necessary, was 11 ordinary pails full to 1 barrel of cement.

The cribs were sunk by a 12-in. Joliet pump and by shoveling, and were filled with concrete made of Louisville cement, sand, and broken stone up to 2 ft. below low water; there being nothing unusual about this work, it is not necessary to give any particulars of it.

As for the neat work, there having been very little of such work done, there was no precedent, and consequently no close specifications were made.

The method of building the neat work was as follows: After the crib had been filled with concrete and the surface leveled off, the center lines of the pier were located and a frame of 2 in. × 8 in. plank, the shape of the pier, and 4-ins. larger to allow for lagging, was placed in exact position and held by pieces spiked to the crib. On this frame upright posts 6 ins. × 6 ins. and 5 ft. 10 ins. high, with a batter of ¼ in. per 3 ft. were set in the position shown on drawing, then the feet spiked to the frame and another frame, similar to the first, but 6 ins. narrower, placed on them. This again was brought to exact position and braced to the crib and the frame completed by putting lagging of 2-in. plank inside the posts and spiking to them. This lagging was horizontal in the body of the pier and vertical (2 ins. × 4 ins.) at the ends, beveled pieces being introduced in the ends at intervals to make up the difference of diameter of the upper and lower circles.

Next, 2 ins. × 6 ins. planks were placed across on the top of the posts, running clear through the pier, to act as braces. In the rest of the frames these



Red River Bridge. St. Louis & San Francisco Railroad. Pier with Framing.
JAS. DUN, Chief Engineer. C. D. PURDON, Constructing Engineer.

braces were allowed to extend about 6 ft. on each side, and the frame braced by spiking plank to them and to the vertical posts. After a section of frames was completed, a bed of cement about 2 ins. thick was spread all over the concrete in the crib. On this the rough stone, in such pieces as one man could easily handle, was placed so that no two pieces would be closer than 2 ins., nor any piece within 2 ins. of the frame, the stone being thoroughly wet before laying.

Next, on this course of stone another bed of mortar was placed, sufficient to fill all the spaces between the stones and remain about 2 ins. thick above them. It was then well rammed with rammers made by inserting a handle in a section of a pile; except at the edges, where a rammer made a 2-in. plank cut in the shape of a spade was used, to insure a perfect skin of cement without any breaks. After this had been well rammed another layer of stone was placed and covered with mortar as before, and so on.

The coping, which was made similar to the body of the pier, was finished by about 1¼ in. of cement mixed with sand 1 to 1, fluid enough to be struck off by a straight edge, the top of the frame being dressed and leveled for that purpose.

I may mention here that the reason for building the frame in 6-ft. sections, instead of building the whole frame at once, was that most of the material was handled from barges in the river and the use of 6 ft. sections saved hoisting material.

The drawings show the framing of the piers; and one taken from a photograph, shows a pier almost completed, with the frame all in place.

After a pier had been completed the frames were removed and the braces running through the piers cut off by a chisel inside the concrete. Then, to make a smooth surface, the pier was thoroughly wet and plastered with a mixture of 1 part sand to 1 part cement, after all rough or loose portions had been scraped off. This was mainly done for appearance.

The cement used was ALSEN'S German Portland, and about 1⅛ barrels per cu. yd. of completed pier were used.

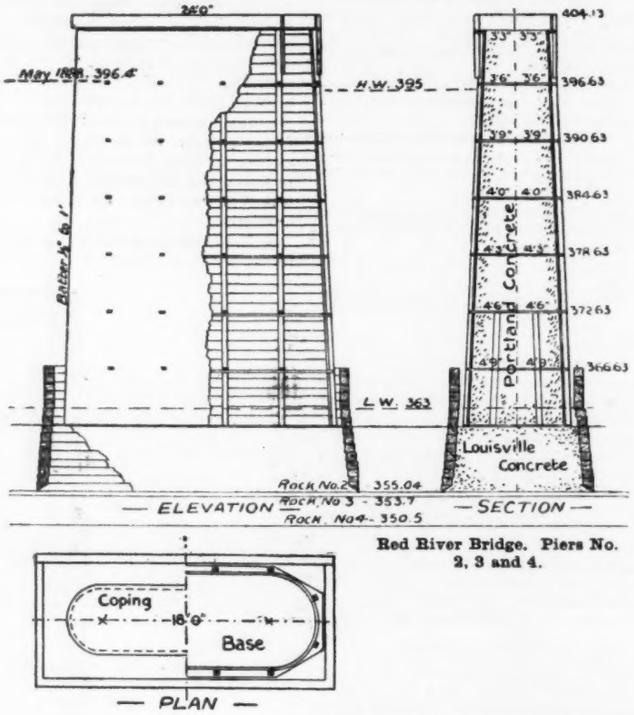
On May 7, I had an opportunity of inspecting them after a most extraordinary flood in the river, caused by a waterspout, in which flood the river rose 1⅛ ft. above the highest water known, the current being estimated at 8 to 9 miles per hour and very large quantities of drift running. Among the drift were cottonwood trees 2 ft. to 3 ft. in diameter, many of which I am informed, broke on the piers from the force of the current.

No damage whatever was done to the piers and no greater marks left by the drift than could be made by a stick held in the hand and dragged across the surface.

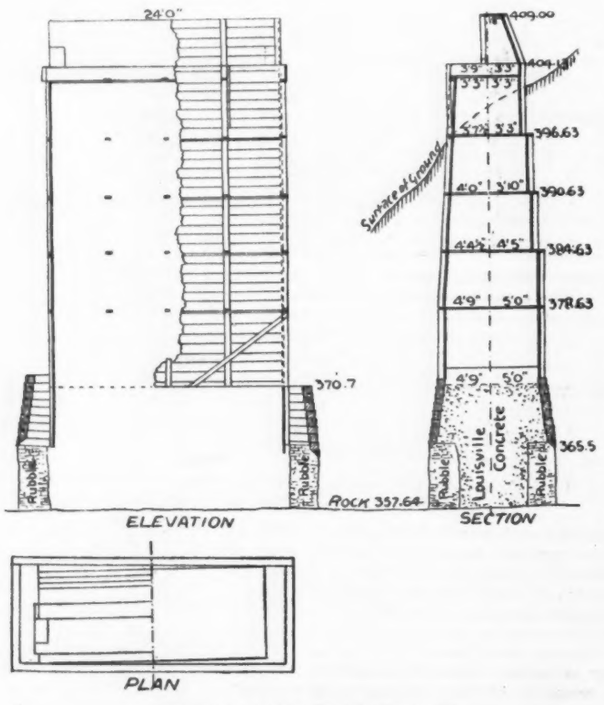
It is the opinion of the bridge inspectors of the St. Louis & San Francisco Railway, who watched the bridge during the flood, and who are men of considerable experience, that had the piers been built of masonry of such stone as could have been obtained, they would not have been able to withstand the drift, and the bridge would have been destroyed.

The only apprehension I had was that a large log, striking a pier "end on", might crack or break the surface of the pier, and a succession of such attacks finally cause its destruction. Now, after the severe manner in which these piers have been tested, I have no fears of them and have no hesitation in recommending piers of this kind as first-class work, equal to any masonry, and superior to the majority of railway masonry when stone has not been of the very best quality.

The bridge consists of three spans 200 ft. each, three of the piers are of rectangular body with semi-circular ends; the other pier, or South abutment having square ends, battered face, back plumb, with offsets, best of materials similar to the river piers.



Red River Bridge. Piers No. 2, 3 and 4.



Red River Bridge. South Abutment.

German Railway Statistics.

The cost of maintenance and repairs during 1887 was $25,000,000 or $650 per mile of track. There were in use 12,642 locomotives, 10,014 tenders, 23,224 passenger coaches with room for nearly 1,000,000 persons, 251,735 baggage and freight cars with a capacity of 2,456,793 tons, or an average of 4.79 tons per axle.

About 275,000,000 passengers were carried, of which 0.63 per cent. were in the first-class, 10.73 per cent. in the second-class, 65.3 per cent. in the third-class, and 20.99 per cent. of the fourth-class. The average distance traveled per passenger was 17.5 miles, and the average fare per mile was 1.4 cts. About 160,000,000 tons of freight were transported. The average distance per ton was 65 miles, and the weight per axle when loaded was 3.58 tons, and on an average 2.29 tons. The receipts from 1-ton mile were 1.7 cts.

The total receipts were $11,000 per mile. The expenditures were $6,200 per mile, or 56 per cent. of the receipts, which is equivalent to an interest of 4.42 per cent. on the capital invested. To operate the roads required 12.6 persons per mile, and for the shops 2.3 persons per mile.

ANOTHER derailment on a switch occurred on the Brooklyn bridge, May 24, the last truck of the rear car jumping the switch and injuring two men slightly. The switch would appear to have been thrown too soon, from the accounts. The switching is all done by hand.

Friction Catch for Plumb-Bob String.

The little device of which we give a full size illustration, designed by Mr. WOLCOTT C. FOSTER, of Brooklyn, N.Y., will, we think be generally regarded as very neat and convenient, and one which should form a part of every plumb-bob string.

A piece of flat hard brass about ¼ in. wide, $\frac{3}{32}$ in. thick, and 2 ins. long, has three holes bored through it as shown in the full size figure herewith. The top hole is countersunk on both sides, while the other two are not countersunk at all but each has a slot cut into it from the alternate edges. The slots are just large enough to permit the plumb-bob string to be passed through them.

The end of the string is passed through the upper hole and permanently tied. The string is then looped over the hook beneath the instrument and the branch to which the plumb-bob is attached, threaded through the slots into the two lower holes.

The great advantage of this way of fastening is the ease and rapidity with which the plumb-bob may be suspended from the instrument without the bother of tying a knot. The string is easily lengthened or shortened by simply sliding the piece of brass up or down it.

Though the idea of using a piece of metal, wood or leather with three holes in it is not a new one, that of having the slots cut into the holes from the edges is new, we think, and a decided improvement. The cost of this little contrivance is almost nothing, and we suggest to manufacturers and dealers that they will do well to furnish it with instruments, or keep them on sale by the dozen.

ENGINEERING NEWS.

A NEW scheme for bridging Dover straits has been brought out by a prominent French contractor named HERSENT. His structure is to be 20 miles long and the spans 1,600 ft. apart. It is estimated by him that the cost will be $32,000,000, and the time of building six years. The point which still remains dubious is when it will be begun.

ACCORDING to Lieut. HENRY P. ALLEN'S report of his explorations of the Copper river in Alaska there are large deposits of copper along this stream, in the vicinity of Mount Wrangel about 200 miles from the coast. Nuggets of pure copper, specimens of bornite, a sulphuret of copper and iron, and knives and bullets of pure copper have been found in possession of the natives. The waters of the Chittyto river, which is about 15 miles long, are of a deep yellow color, due to mineral impregnation, and are said by the natives to be poisonous. The pebbles and boulders in this river bed are much discolored by copper stains and it is said that salmon will not ascend the stream.

Mr. H. A. WILLIAMS, of the Williams Manufacturing Co., Taunton, Mass., has had patented a new machine for rolling wire cold. It consists of a continuous roll train connected by friction clutches and having a common driver, each pair of rolls having a greater speed than the pair preceding it.

The smallest wire is rolled cold from ⅛-in. wire rods, thereby saving the waste due to scale, estimated at 5 per cent. per heat, and all expense of furnaces, heating and annealing. The wire is said to be so flexible as to permit winding about a cylinder of the same size as itself or tying in a knot, without showing signs of fracture under the microscope. Metals welded by the THOMSON electric welding process have been reduced five sizes at a pass by this process and when finished the weld could not be detected.

A NEW kind of steel, containing some 13 per cent. of manganese and almost wholly unmagnetizable, has been described before the British Association, and the fact of experiments showing that the intensity of magnetization capable of being imparted to it is some 6,000 times less than that which can be given to ordinary steels, indicates its peculiar value for the construction of iron ships with no compass error, the bed plates of dynamos, resistance coils, non-magnetizable watches, etc. One of the most curious properties of this steel is that it is annealed in the opposite way to what is usual—that of hardening by being suddenly cooled, whereas manganese steel is softened by this process. Its tenacity is greater than that of ordinary steel; thus, the breaking strain of a No. 19 wire of hard manganese steel is found to be 110 tons per sq. in. or nearly double that of ordinary steel wire, and only exceeded by the finest and hardest used for piano fortes. The resistance of the new steel wire is found to be very high, about six times that of iron, and three times that of German silver; its change of resistance for temperature also proves to be much less than iron.

THE chance for the use of electric engines on the London underground railways is now being investigated by Sir EDWARD WATKIN. It will of course, if successful, add greatly to the comfort and cleanliness of those lines, which badly need some such betterment, and furnish a much pleasanter means of getting about London than now exists.

IT is reported that the storage-batteries on trial on a Brussels tramway have deteriorated so that the cost of running is increased 7 cts. per car-mile. This makes the cost of running nearly 11 cts. per car-mile, which is slightly in excess of the estimated cost of horse-cars, which is 10 cts. per car-mile. The preceding estimates were under the least favorable conditions for the batteries.

THE following estimate of the power required to run an electric car was made by Mr. HUBER and appeared in the *Electrical Engineer*.

The energy required to be stored in the cells in order to draw a load of one long ton, in ordinary weather, over 1 mile of average road, the gradients on which do not exceed 2½ per cent., on an average, is equivalent to 125 watts exerted for an hour. Calling the daily run 70 miles, and the weight of the car eight tons, it follows that the battery must be of such proportions that it can give out during the run as much energy as is equivalent to $70 \times 8 \times 125 = 70{,}000$ watts exerted for an hour. As this energy is not used during one hour, but distributed through, say, 14 hours, the battery will only need to be $\frac{1}{14}$ of 70,000 watt-power, or 5,000 watt-power. If there are 125 cells, each having an E. M. F. of two volts, the E. M. F. of the battery will be 250 volts, and in order that it may develop the necessary 5,000 watts it must give a current of 20 ampéres, *i. e.*, $5{,}000 \div 250 = 20$. Ohm's law ($C = E \div R$) shows that if the current is 20 and the E. M. F. 250, the total resistance must be 12.5 ohms. Most of this resistance will be in the motor, which should be designed accordingly. It takes 746 watts to equal 1-horse power, so that 70,000 watts exerted for one hour is the same as $70{,}000 \div 746 = 93.8$ horse-power exerted for an hour. We may assume that the generator gives out 80 per cent. of the indicated horse-power of the engine that drives it. The engine should therefore be large enough to be able to exert 117.2 horse-power for one hour, if it did the charging all in one hour, since 80 per cent. of 117.2 is 93.8. If the charging of the battery lasts 20 hours instead of only one hour, the engine need be only $\frac{1}{20}$ as large. That is, it will not need to exert more than 5.9 horse-power.

THE *Zeitschrift für Transportwesen und Strassenbau* gives the following receipt for making timber fire-proof. The timber to be prepared must be at least 3 hours in a mixture of 27½ parts (by weight) of sulphate of zinc, 11 parts potash, 22 parts alum, 11 parts manganite in lukewarm water. Then is added slowly 11 parts by weight of sulphuric acid sulphate (60° Baumé) so that the fluid lies some centimeters deep over the surface of the timber. The wood saturated with this fluid is then left to dry in the air.

A WIRE rope half a mile long, 6¼ ins. in circumference, and weighing 7½ ton, has been manufactured at Gateshead, Eng. There are six strands of nineteen wires each in it, the breaking strain of the whole being 175 tons. This immense rope is to be used in North Wales.

ACCORDING to experiments recently made at the Royal Polytechnic School at Munich, the strength of camel's hair belting reaches 6,315 lbs. per sq. in., while that of ordinary belting ranges between 2,220 lbs. and 5,260 lbs. per sq. in. The camel's hair belt is said to work smoothly and well, and is unaffected by acids.

Mr. R. P. MCCORMICK, of Kansas City, has purchased 160 acres of land just north of Fort Scott, Kas., underlaid by fine cement rock, and will start new cement works with a capacity of 500 bbls. of cement per day, or three times the present output of the Fort Scott Cement Works; 75 men will be employed. The rock is said to give a cement of fine quality.

THE State University of Kansas has followed the example of Cornell, Johns Hopkins, Stevens Institute and other eastern colleges and established a special course in electrical engineering. The legislature at its last session appropriated $5,000 for the apparatus and machinery necessary to fit up a suitable laboratory.

The railroad leading from the east shore of the Caspian Sea in a southeasterly direction to the inner part of Asia, passes through a stretch of country which is devoid of timber. It was necessary therefore to transport the ties from a great distance, and when it was found that both the atmosphere and the ants rapidly destroyed them, stone blocks were used instead. The native stone, however, did not seem well adapted to this use, because it was found very difficult to make the spikes take a good hold without causing the blocks to split. Inasmuch as the territory through which the railroad ran had large quantities of natural asphalt it was suggested to use this material for bedding the rails. This trial was so successful that asphalt is now generally used in that locality. Blocks are formed 9 ins. in depth and 18 ins. sq. They are laid under the rail so that the axis of the latter is over the diagonal of the block. On the upper surface a groove is cut to receive the rail which is held fast by spikes driven into holes bored into the asphalt and secured with small wooden wedges. The rails are held together by iron rods. The blocks are prepared from the bitumen, obtained by distilling the crude asphalt and mixed with 75 per cent. of powdered limestone and 25 per cent. of gravel. This mixture is then compressed into the above described blocks.

The Actual Status of the Panama Canal.

We presume a good many of our readers have, like ourselves, wished for something like definite evidence as to just what was the status of the work on the Isthmus, and we are at last able to present it in the progress profile and views of the work at four important points which appear in this issue, and which tell their own story fairly well even without the aid of the notes which accompany them, prepared for the most part by an engineer who has recently been all over the work in person, and which we believe to be entirely reliable.

Certainly the photographs are reliable, and we have selected those reproduced in engravings from a large number in our hands as those which best illustrate the actual status of the project at the present date, or at least, as it was six or eight weeks since. The profile is of somewhat earlier date, showing the work as it stood Jan. 1 of the current year, but as it covers all the work done in the seven years (1881-8) since the work on the canal was started, it is apparent that the condition of the work cannot have so greatly changed in the six months or so since the profile was made as to greatly affect its appearance. This profile is official, as respects the showing of work done and undone. The lower (lock) profile was issued by the company in January of the present year, but it has never been published except in the general form reproduced in our issue of Feb. 11 from *Le Génie Civil*, showing the proposed new lock system, but giving no information as to the proportion of work done and undone. A few copies of the lower profile as we now print it were issued in Paris at the time the new loan was being pushed before the Chamber of Deputies, with the idea of showing how greatly the locks reduce the amount of work to be done, but it was speedily seen how damaging it was to the company, even as respects the chances of carrying through the lock canal, and accordingly all possible

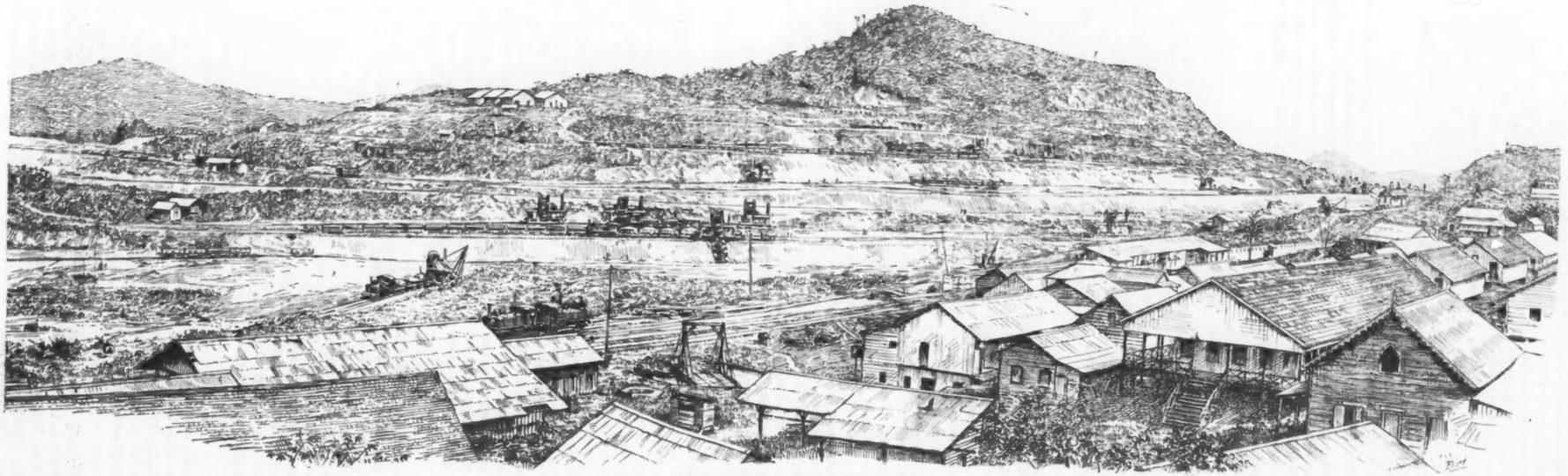


Fig. 1.—The Great Culebra Cut.
Looking toward the Pacific. The high hill shown is the one giving trouble by sliding.

Fig. 2.—The Emperador Cut.
(Cut 20 m. above the new grade.)

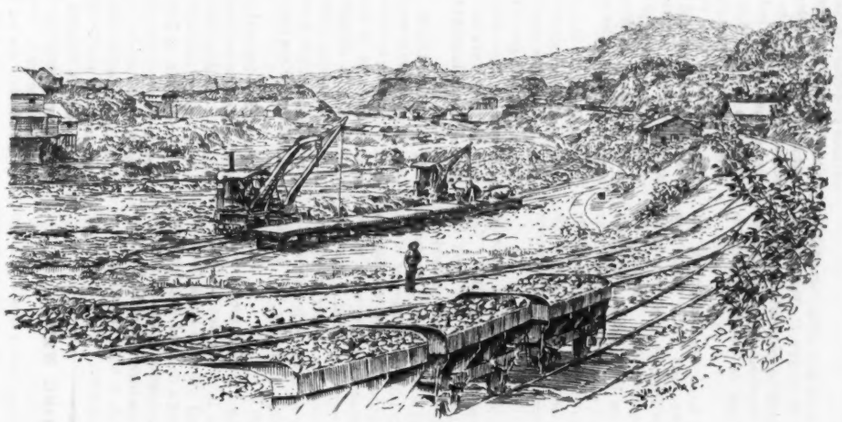


Fig. 3.—Bas Obispo Cut.
Site of Gamboa Dam and First Crossing of the Chagres.

THE ACTUAL STATUS OF THE PANAMA CANAL.

copies were at once suppressed. That this was done, and how effectively it was done, will be seen from the following extract from a speech of M. RONDELEUX, in the Chamber of Deputies, April 26, 1888, on the "Panama Canal Lottery Loan Bill".

"There is a map, printed for the Panama Company which the Committee (on the Loan Bill) did not see, except one member, and he in a very roundabout way. That map, which is dated January, 1888, shows the state of the work by indicating upon a profile the amount of excavation which had been done up to Dec. 31, 1887, and the amount remaining to be done. The Committee called upon the company for that map, on April 21 and 23; perhaps it went astray *en route*; certain it is that it did not reach us. To-day a map is distributed to us which is a copy of the one I speak of, but it does not come from the company."*

The accompanying map is from the copy referred to by M. RONDELEUX, and we esteem ourselves fortunate in being able to present it to our readers, for the first time in print. Its official origin ensures that it does not at least lean against the company in its showing, and we may naturally believe somewhat in its favor, as for instance, by showing center depths, when the slopes are not fully out above them. The only change made from this official profile is at kilos. 46-7, where the fact that certain work has to be refilled is indicated by hatching below the lock formation level.

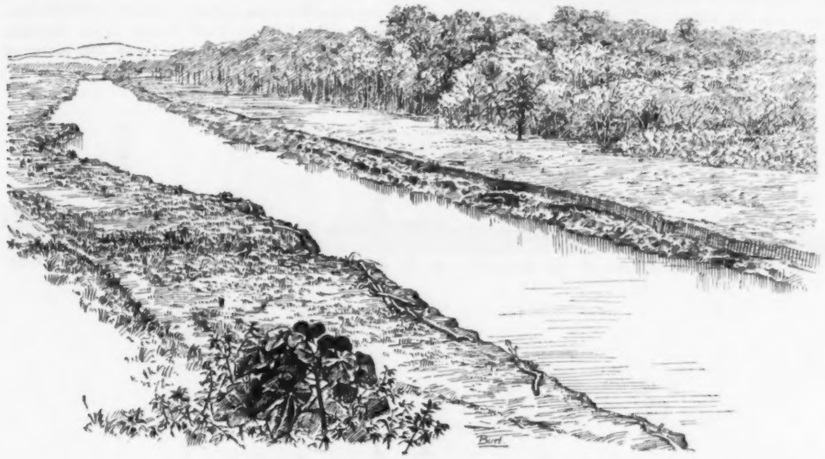


Fig. 4.—The "Finished" Section, Kilos. 1 to 3.

We now proceed to explain in detail the profile and each of the four views, so far as they seem to require explanation, and elsewhere summarize editorially some further general facts in regard to the status to date of the work, giving likewise our own conclusions in regard to it, which we need not repeat here. The most important of all the facts within our knowledge—and certainly a much fuller presentation of facts than has ever yet appeared in press anywhere—are here laid before our readers, and from them they can draw their own conclusions, if they do not like ours.

THE PROFILE.

This profile was prepared for the Panama Canal Co., and printed during the current year, for the purpose of showing the work necessary to complete a lock canal. It was afterwards attempted to suppress it, as already noted. It shows, in a very striking manner, the amount of work done upon the Panama canal during the seven years that it has been under construction, and gives an approximate idea of the amount necessary to complete the canal at sea-level: a much more correct idea than it has been possible to form heretofore.

The profile should be considered in the light of M. DE LESSEPS' repeated declarations that the lock system is only a temporary expedient, and that the company is bound to complete the canal to the sea-level, according to its original prospectus. It should also be borne in mind that there is no adequate water supply for the upper lock, 150 ft. above the bed of the lowest level; that the problem of controlling the waters of the Chagres river is still unsolved; and that the other elements of doubt and difficulty concerning the lock canal are, if not as many and as great as those which surround the sea-level project, yet very many and very great.

The profile is from the copy referred to by M. RONDELEUX in the speech from which we make an extract above.

The first announcement made by the Panama company of the cube that would remain to be extracted under the lock plan was 40,000,000 cu. metres. In reporting the work done in February, the *Bulletin du Canal Interocéanique*, of May 2, said: "There remains to extract 32,132,244 cu. metres."

A careful calculation, by scale, of the amount of excavation for the lock canal, as shown on the profile, between kilometers 18 and 67.300, conceding the completion of the two ends, (though they are not complete by any means), and taking a slope of 1½ to 1 throughout, (which cannot be maintained in the higher parts), gives a total of 37,250,627 cu. yds. The details are as follows:

Kilometers.	Average depth.	Total cu. yds.
18 to 23 (5)	38½ ft.	3,288,266.
23 " 26 (3)	10 "	561,000.
26 " 29 (3)	30 "	2,468,037.
29 " 32 (3)	32 "	2,632,960.
32 " 34 (2)	20 "	880,000.
34 " 37 (3)	35 "	2,987,013.
37 " 43 (6)	15 "	1,391,231.
43 " 48 (5)	0 "	
48 " 50 (2)	50 "	2,750,000.
50 " 53 (3)	41·5 "	3,619,020.
53 " 54 (1)	75 "	2,401,629.
54 " 55 (1)	120 "	3,709 688.
55 " 59 (4)	30 "	2,860,000.
59 " 61 (2)	15 "	463,743.
61.309 to 67.309 (6)	41·5 "	7,238,040.
Total cubic yards.		37,250,627.

This aggregate amounts to 34,081,086 cu. metres, and takes no account of the work yet to be done in Panama bay, or in the coral rock between kilometers 67 and 74, and without the channels for the deflection of the Chagres, the Rio Grande and the Obispo, amounting certainly to several millions of cubic metres. Besides these there is a contract between the canal company and Messrs. BARATOUX, LETELLIER & Co., as noted last week, signed on Dec. 30, 1887, which provides for the excavation of a channel, of the same size as the canal, parallel with it, and 69 metres distant from it, between kilometers 62.200 and 68.100. The amount of excavation is stated in the contract at 3,360,000 cu. metres, which increases the known total to 37,441,086 metres, without the deviations and the terminals.

The excavations for the locks will also be considerable in quantity, and it will be strange if they are not likewise of a difficult and tedious nature, since the locks are located in rock. It therefore appears far within the probabilities to place the total excavation remaining to be accomplished for the canal, with ten locks, at 50,000,000 cubic meters. If the upper locks be abandoned, as contemplated by the terms of the Eiffel contract, it will add largely to the cube and the difficulty.

Now the company's rate of excavation, even with the help of the large figures from the Colon—Gatun section, has not averaged 1,000,000 cubic meters per month, the past two years through. At the best rate of progress, therefore, and with the most liberal allowances, there is work enough to consume four years, and that would involve the disbursement of something like $80,000,000 for interest and sinking fund of the debt and expenses of administration without counting a dollar for work or material on the canal itself.

Though the work accomplished thus far has been the easiest that the line presents, still, more than one contractor has succumbed before the difficulties of the Culebra. Some of the richest and most experienced firms of Europe have declared the tasks of that portion of the line beyond their power to accomplish, and have abandoned their contracts. Those tasks have not been lightened nor the difficulties lessened by the operations hitherto effected. The laborers are not more numerous nor more efficient than they were when Señor TANCO ARMERO declared that the results of their work convinced him that there had never been more than 5,000 men employed, though the company claimed to have 15,000.

Again, the water for the supply of the lock system, so far as is known, is to be furnished from the Chagres river. In the dry season the flow of the Chagres is at the rate of 10 cu. metres per second, of the Obispo 1 cu. metre, and of the Rio Grande 0.4 cu. metres. The three streams would therefore supply some 259,977,600 galls. per day. The capacity of each of the locks is 40,000 cu. metres, and each vessel crossing the summit level will require the two locks to be emptied once, using something like 80,000 cu. metres of water. The Panama Company claims a tonnage of 10,000,000 per year, or 28,000 tons per day, representing 20 vessels of 1400 tons each, although this seems to us a most exaggerated estimate. The water required for their transit would be 322,400,000 galls. per day. The evaporation and filtration, estimated at one per cent. per day, would entail a loss of something like 47,300,000 galls. making the daily requirement amount to 369,700,000 galls. The supply is 259,977,600, and the shortage on this basis 109,765,260 galls.

We should hardly expect from this computation that there would really be any shortage of water supply, since we have no belief that the traffic will reach 10,000,000 tons, or anything approaching it, for a long period of years, but it seems to be admitted that pumping will be necessary, and it seems to be proposed to provide for it. Therefore, we apprehend that this water supply estimate is really too liberal.

However this may be, in the rainy months opposite conditions will prevail. The Gamboa dam, built to retain the waters of a six days' flood (the greatest rainfall of recent years) may fulfill the expectations of the engineer, but after the water leaves the dam, it receives the drainage of the country from Kilometers 45 to 23, and in a six days' flood the rise becomes enormous. In some cases the the Chagres, flowing in its original channel, approaches within a few feet of the canal, when it is suddenly turned into a deviating channel at right angles to its former course. Unless walls of masonry are interposed at such points, to resist the eddies, the river will be extremely liable to break throgh the banks into its original channel, and destroy the canal.

Two opposite facts need to be borne in mind in studying the progress profile. On the one hand, owing to the slopes, 10 ft. off the top of the cut represents a much larger proportion of the volume taken out than it does of the total center height. On the other hand, owing to the excavations having been conducted until very recently on the basis of a sea-level canal (if they have in fact been so conducted) there must be a good deal of wastage in unnecessary top widths for a lock canal, and what is far more important, cleaning out the bottoms, and dressing up such vast earthworks will be vastly more expensive per cubic yard than skimming off the top surface, especially as rock has to a very large extent been let alone so far.

The rock, moreover, is not of a particularly favorable character for cheap working. It is soft; so soft that ordinary methods of working by drills have been largely abandoned. On the Obispo-Culebra section the present method of working, as we shall show more fully later, is to sink large shafts, put a **T** at the end of them, blow up with powder and glycerine, and then break up and remove the mass by task work, loading into buckets, which are swung by cranes to the cars. No statistics are issued of the relative amount of rock and earthwork so far, but

*From the *Journal Officiel*.

we may be quite sure from the profile that the proportion of rock so far has been much less than it will be hereafter.

FIG. 1.—THE GREAT CULEBRA CUT.

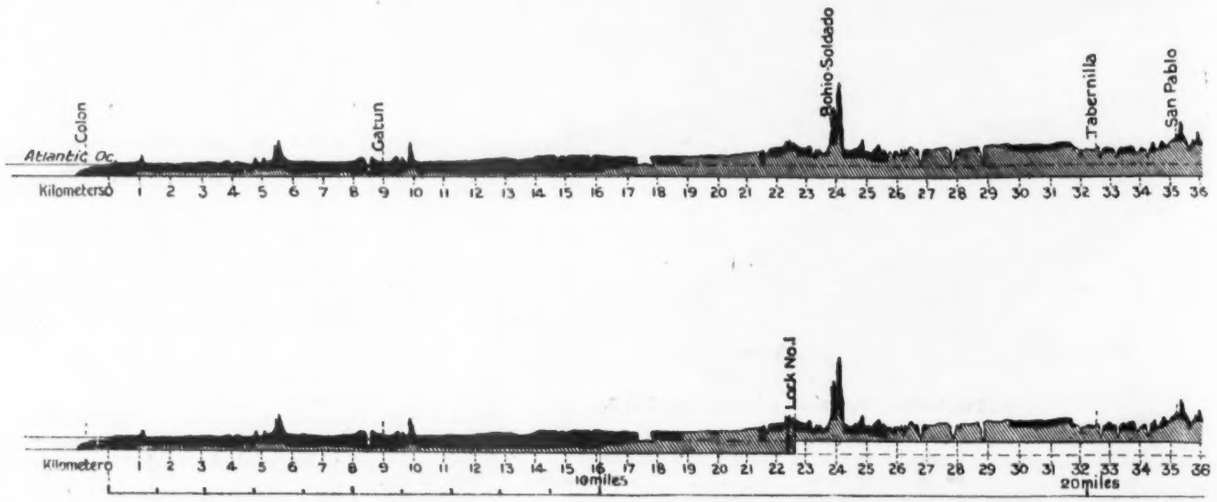
This view, taken in April, 1888, shows the summit of the canal in the center of the Culebra cut, at kilometer 54, and exhibits the maximum amount of excavation done at any point on the line. The depth from the original surface to the bed of the sea-level canal at this point was 354 ft. About 93 ft. have been taken out, leaving 111 ft. to be excavated to the bed of the upper lock-level, as shown in the profile, or 261 ft. to the bed of the sea-level canal, through a length of 3,300 ft. The abandonment of the upper lock would add 30 ft. in depth for a distance of 3⅛ miles; making the maximum cut 141 ft. to the bed of the next lock-level, and the excavation for the lock canal through the central mass between Paraiso and Haut Obispo, a distance of 5⅛ miles, would vary from 90 to 120 ft., apart from the 3,300 ft. of the maximum cut. The profile shows at a glance that endless-chain-of-buckets type, one or two of which are seen at work in the picture. These were satisfactory in working upon the sandy material of the Isthmus of Suez, but they prove much less effective when attacking the hard-pan and stiff clay of the Culebra. In connection with this plant are used Belgian 36-ton locomotives, and the Everard iron dump-cars, as seen upon the railway tracks in the picture, which was taken while work was going on at the usual rate ,as we understand, and will enable those familiar with public works to appreciate how likely it is that the remaining work will be completed by 1890 or 1891, when this is what has been accomplished in the 7 years, 1881-8.

FIG. 2.—THE EMPERADOR CUT.

This view taken in 1888, shows the canal line at kilometer 50.500, in the Emperador section, at the other end from Culebra of the great central level. The view is taken looking toward the Atlantic through the Valley of Emperador, in the direction of Haut Obispo. On the extreme left may be seen the dumping grounds for the excavations, this reason the profile shows a shaded area under the formation level between kilos. 45 and 48.

At this point the Chagres first crosses the line of the canal, taking it at right angles, as shown at the upper right center of the picture, where there is a bridge across the river, for the passage of trains working upon the end of the dam west of the Chagres. It is an iron through-truss bridge of two spans, and is long and high enough to clear the floods. The cars in the fore-ground are loaded with rock from Obispo (toward the Pacific), which is to be deposited upon one end of the Gamboa dam, a mile and a half farther on toward the Atlantic. This rock is of volcanic formation, and disintegrates when exposed to the air. No rock has yet been found in this section of proper quality for making concrete. The nearest is at Bohio Soldado, about 14 miles away toward the Atlantic.

The two ridges at the right of the picture, scarcely distinguishable from a single summit, are the tops of the hills Obispo and Santa Cruz, between which the Chagres flows, and upon the sides of



Reproduction of a Progress Profile of the Panama Canal Published

Showing the Amount of Work done towards building the

NOTE.—The lower profile is the one issued by the Company, primarily to show the lock system and the small remaining amount of work. The upper profile has been added to exhibit more clearly to the eye what was the status of the work as a sea-level project without locks when this intention was abandoned.

in general very little progress has been made in these difficult sections.

The surface width for a depth of 204 ft. from the original surface to the bed of the upper lock-level, at a slope of 1½ to 1, would be 750 ft. At this slope, which is the one now adopted, great difficulty is experienced from landslides, one of which may be seen in the upper center of the picture, on the face of the mountain. In consequence of this caving tendency the terraces have already been forced backward and upward on the mountain side, which has necessitated the readjustment of the lower terraces, and this characteristic will render further widening necessary as the cut is deepened.

In the earlier excavation it was possible to dump the material on both flanks of the mountain, upon the same level, and about half a mile away; but on the lower terraces the haul is largely increased, the dumping grounds being outside the cutting, on the extreme right and left, and requiring long trestles, 50 and 60 ft. high, reaching out over the adjacent swamps that are being rapidly filled up. As the excavation descends the length of haul from the center of the works increases in a heavy ratio.

On the extreme left of the picture, in the lowest cutting in the foreground, the depth remaining to be excavated is over 100 ft. to the lock-level, or 250 to the sea level. In proportion with the deepening of the cut the hauling engines must overcome a heavy grade over an increasing vertical distance, and as the dumping grounds fill up, new ones must be found farther away.

It will be apparent that the excavation on the upper levels was accomplished with a minimum of labor and expense, and that as the cut descends the work will entail a rapidly increasing consumption of time and money in its execution.

The excavators chiefly employed here are of the reached by rail, and already used to a large extent In the left center are the houses and shops of the contractors and the huts for the laborers.

The work done thus far amounts to little more than the removal of the surface earth. The excavation still required along this immediate front for two miles is 60 ft. deep to the lock level, over 210 ft. to the sea level. A distance of a mile and a half, to kilometer 53, requires from 90 to 120 ft. of excavation to the lock level, or 240 to 270 to the sea level while at kilometer 47, the excavation is 15 ft. below the level of lock No. 4, necessitating enbankments, as in the case of lock No. 3, at Gamboa, next to be described.

The deviation of the Rio Grande is unfinished, rendering progress exceedingly difficult in the rainy season, as the river overflows the works. There was erected here a through-truss iron bridge to carry the Rio Grande over the canal and unite it with the Rio Obispo on the opposite bank, but on account of the change from the sea-level to the lock system orders were sent from Paris in April to have the bridge taken down. This has been done, and it is stated at an expense greater than the original cost of the erection, and the parts are stored away to await further developments.

FIG. 3.—BAS OBISPO CUT. SITE OF GAMBOA DAM AND FIRST CROSSING OF THE CHAGRES.

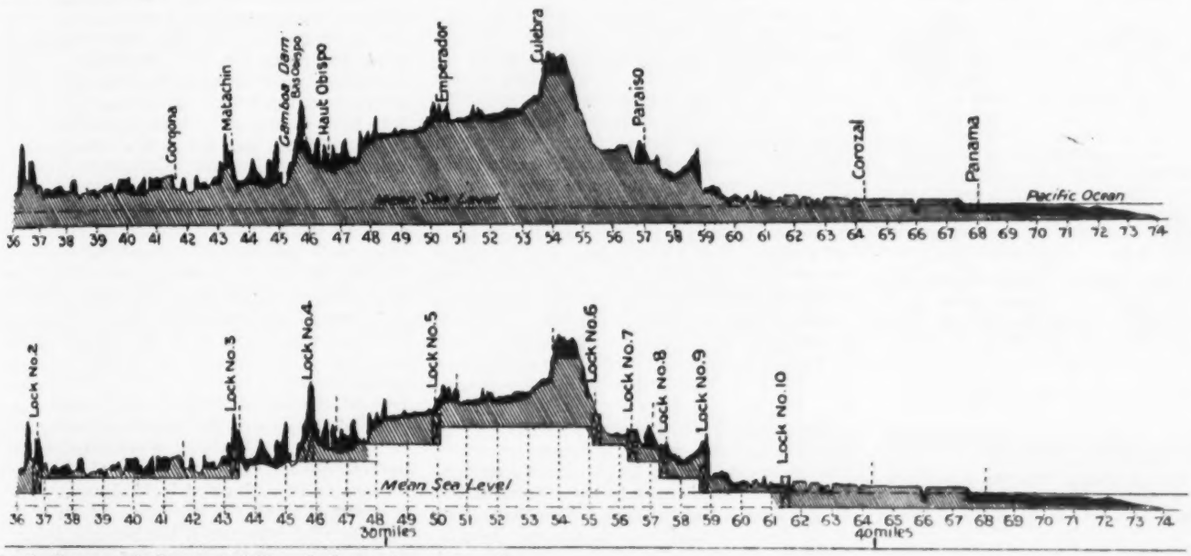
This view shows the line of the canal at about kilometer 45.200, immediately under Bas Obispo and the proposed site of lock No. 4. The observer is looking toward the Atlantic. The line of the canal at this point had already been excavated below the proposed level of lock No. 3 when the new system was adopted, and it will now be necessary to raise embankments on either side for two miles, to restrain the canal within its channel and prevent it from spreading over the surrounding country. For which the ends of the Gamboa dam are to rest. On the terrace of Obispo, on the right, is a construction railway for work on the east end of the dam.

The Gamboa dam, as originally proposed by the French engineers, was to be 975 ft. long on the base, and 113 ft. high, with reveted slopes of 4 to 1, and was to consist of 10,000,000 cu. metres of rock and clay. The site was to be dredged some 60 ft. to a solid foundation. These plans have been abandoned, and the proportions of the dam now under construction are not known, but its total contents are stated by Mr. JACOBSON to be 3,000,000 cu. metres, whereof 30,000 have been deposited on the flanks of the hills at the two ends. These deposits are dumped from cars upon the natural surface, the new theory of the engineers being that the immense weight of the mass will settle it to a compact foundation. It is the opinion of engineers in charge of the work, as expressed by Mr. JACOBSON, whose statement we summarized in our issue of May 19, that the central part of the dam, opposed to the current of the Chagres, must be completed and solidified during a single dry season of three or four months, or it cannot be built at all, as an incomplete structure could not withstand the floods of the wet season. We are not prepared to express any opinion on this point, but to do otherwise must evidently be at a certain risk.

At many points between Gamboa and Colon, during the rainy season, the bed of the canal is lower than the Chagres, and is overflowed by it,completely stopping work on those sections. The sudden breaks in the surface shown on the profile are all crossings of the Chagres. Hence the small results shown for seven years' operations in this portion of the line, and it is apparent that until the deviations for the river on both sides of the canal are adequate to con-

trol the maximum drainage, the work on these lower sections cannot make substantial progress. One of the objects of the construction of the Gamboa dam is to control the flow of the Chagres so that this part of the canal may be protected from its floods, but the cube of the deviations, which have so far been made or proposed, is only about one-quarter of the capacity required by the river in the height of the rainy season, the constructing engineers having adopted the view that the river will gradually enlarge the capacity of the deviations to its own requirements.

The profile shows the amount of work remaining to be done on the axis of the canal, but does not show the deviations on the two sides. While the location of the canal is made with a view to the most advantageous operation, it is not always possible to find equally favorable locations for the parallel channels. In places the amount of excavation in the deviations exceeds the cube of the canal


Gorgona
Matachin
Gamboa Dam
Bas Obispo
Haut Obispo
Emperador
Culebra
Paraiso
Corozal
Panama
Mean Sea Level
Pacific Ocean
36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
Lock No.2
Lock No.3
Lock No.4
Lock No.5
Lock No.6
Lock No.7
Lock No.8
Lock No.9
Lock No.10
Mean Sea Level
36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74
30miles
40miles

by the Company in January, 1888, and afterwards suppressed.
Canal up to Jan. 1, 1888. Work started in the spring of 1881.

NOTE.—Between kilometers 46 and 48 there has been some hatching added below the bottom grade line of the canal, to represent to the eye the work which must be done in refilling the canal and banks thereof between kilometers 43.5 and 47.5. Between the Gamboa dam and the Atlantic, the Chagres crosses the line of the canal many times, only a part of them being indicated on the profile.

itself, and it will be apparent that its execution involves vastly more doubtful and hazardous elements; because the present bed of the Chagres is almost as crooked as the bed of the Mississippi, and crosses the canal at several points almost at right angles. It is very easy to dig a straight ditch across the middle of these **U** bends, if one has the money to do it with, but it is quite a different matter to make a rushing torrent take these new channels and quietly flow in them, as many an over-confident engineer has found to his cost. In nothing is the past management of the canal open to severer criticism than in leaving this whole problem of controlling the Chagres until after a good part of the work affected by it has been executed.

FIG. 4.—THE "FINISHED" SECTION, NEAR THE ATLANTIC END.

This view exhibits a stretch of the only "finished" section of the canal—that from Kilometer 16 to Colon, which it will be seen both from the view and the profile is not yet finished, as a good deal of work is still to be done on it, though it is navigable for light draft vessels.

The land here is flat and marshy, and whatever may have been accomplished toward making a canal of the requisite depth and width has been done by dredges floating on the surface and discharging mud and water on the banks by means of long pipes overreaching them on either side. Such dredges can be worked in any higher level than this only at enormous expense and trouble, as is shown by the lack of progress beyond Kilometer 16, on the profile.

This open section of the Panama canal has been the subject of much comment and congratulation on the part of interested persons, both here and in France. The contractors have used it to show the efficiency of their work, and the canal company's supporters have printed pictures of it, and elaborated its advantages for developing local trade and for use in transporting material and supplies to the works. In view of the uncontrolled flow of the Chagres, and the liability of this lower portion of the canal to damage from caving and silting, the policy of dredging it years before the whole can be completed, so as to render this part of use, would seem, to put it mildly, very questionable. The monthly cube of extraction reported at Paris has undoubtedly benefited largely by it, and pictures and descriptions of "16 finished kilometres of sea-level canal" may have been of value at certain critical moments, but if the "open section" is ever to form part of an inter-oceanic canal it will probably have to be all dredged out again, some years hence, and the interest on the money paid for it would make a comfortable sum, which has been completely thrown away. It will be apparent to engineers that with the rest of the work in the state shown, this section should still be lying untouched, if the work as a whole was to be prosecuted economically, without regard to the necessity of impressing the gullible and ignorant.

A speech by M. LEOPOLD GOIRAND in the Chamber of Deputies, April 27, translated in the *Evening Post*, will be read with interest in this connection, and puts forward in clear language the extraordinary features of the Eiffel contract. After pointing out that at each appeal for more money the Panama company has announced a fixed date for opening, and the existence of contracts to this effect, and that the opening has now been announced seven times for seven different dates, M. GOIRAND comments on the curious way in which some of these alleged contracts have been cancelled shortly after, and says:

"What is the Eiffel contract? I have read the curiosity from end to end. I have seen many contracts, gentlemen, drafted by the keenest minds, but I have never seen so curious a contract as that. Works to the amount of 125,000,000 fr. are intrusted to M. EIFFEL. Undoubtedly the Panama company, as an interested and prudent owner, binds its contractor by security and guarantees. That is its duty. Having the interests of its shareholders to protect, the company should take security. The security on this 125,000,000 fr. worth of work is fixed at 1,000,000 fr.

"M. EIFFEL must deposit in the company's hands 1,000,000 fr. to guarantee the execution of the work." How is he to deposit it?" In this way: 200,000 fr. fifteen days after signing the contract, in specie or security accepted by the company; and 800,000 fr. in non-negotiable bills—such is the great confidence of M. EIFFEL in the Panama company—signed by M. EIFFEL and payable 300,000 fr. Oct. 1, 1888; 300,000 fr. Jan. 1, 1889; 200,000 fr. March 1, 1889.

"And what do they give to M. EIFFEL? We must believe that M. EIFFEL has the upper hand, for the stipulations he has imposed upon the company are very onerous He is to give the company, as a guarantee, fifteen days after signing the contract, 200,000 fr. in security more or less solid; but what is he to receive? Ah! It is not fifteen days after signature that he receives something, it is upon signing. And what does he receive? He receives, right away, 300,000 fr. He receives another 300,000 fr. thirty-five days after, on Jan. 15, 1888; then he receives 1,100,000 fr. in the three months ensuing, and that independently of all work begun.

"In the same contract is provided a fixed allowance of 1,200,000 fr. for the deviation of water courses which may be made during the period of the work; another fixed allowance of 3,000,000 fr. for maintaining and removing roads of all kind. How are these allowances payable? 400,000 fr. Jan. 1, 1888—note that well—twenty days after the signature of the contract; 400,000 fr. March 1, 1888; 400,000 fr. April 1, 1888.

"But, sirs, this is not all. Of a second allowance of 3,000,000 fr. M. EIFFEL receives 500,000 fr. Jan. 1, 1888, 20 days after the signature; 250,000 Feb. 1, 1888, 250,000 March 1, 250,000 April 1. M. EIFFEL to-day has received 4,000,000 fr.

"Now, gentlemen, compare the conditions of this contract with these truly leonine stipulations. The contract ends on June 30, 1890; at that date the works M. EIFFEL undertakes are to be finished. And if, on June 30, 1890, these works are not finished, and if, by M. EIFFEL's fault, the company cannot put its canal in operation on June 30, 1890, what does the company lose? It loses monthly one-twelfth of the 120,000,000 fr., which it professes that it can earn each year; that is, 10,000,000. To indemnify it for these 10,000,000, do you know what it does exact of M. EIFFEL? One hundred thousand francs!

"We may then assert that to-day M. EIFFEL is the master of the Panama affair. He is master of it, not only by his contract, but by the money he has received. For, if you do not authorize the issue of the lottery bonds demanded by the company, do you believe that M. EIFFEL will give back the 4,000,000 fr. that he has received? It is not probable."

The speech then goes on to point out, in answer to an objection, that this sum is in addition to any work done or purchases made for carrying out his contract, which are covered in very liberal fashion as noted last week, and continues:

"I say that at the bottom of this contract there is something which may appear extraordinary, but of which I shall not hesitate to point out the true character. In brief, two men found themselves at the same moment in presence of undertakings hard to complete, having also a similar notoriety, and, it may as well be said, equally requiring money. These two men have come to an understanding. One has given his name—M. EIFFEL—and the other has given the millions of Panama.

"We remember how at the start M. EIFFEL also tried to put his enterprise into shares; but, less fortunate than M. DE LESSEPS, he could find no shareholders. To-day, thanks to this marvelous contract which I have analysed, we see rising day, by day, the colossal tower which, it is said, is to stand a monument to our national industry. But the *tour de force* upon which M. EIFFEL may especially congratulate himself will be not so much the having reared his tower as having done it with the money of the Panama shareholders."

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EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club of Philadelphia Pa.—Regular meeting, June 2. Secy., Howard Murphy, 112½ Girard.

Engineers' Club of Kansas City, Mo.—Regular meeting, June 4. Secy., Kenneth Allen, 19 Deardorff Building.

Civil Engineers' Society of St. Paul, Minn.—Regular monthly meeting, June 4. Secy., Geo. L. Wilson, City Hall.

American Society of Civil Engineers, New York.—Regular meeting, June 6. Annual Convention at Milwaukee, Wis., commencing June 28. Secy., John Bogart, 127 E. 23d St.

Master Car Builders' Association.—Next convention at Alexandria Bay, N. Y; commencing June 12. Secy., M. N. Forney, 45 Broadway, New York City.

Engineers' Club of St. Louis, Mo.—Regular meeting, June 6. Secy., W. H. Bryan, 709 Market St.

American Railway Master Mechanics' Association.—Next meeting at the Thousand Islands, N. Y.; June 19. Secy. Angus Sinclair, Chicago.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, June 19. Secy., S. M. Wickersham, Penn Building.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, June 20. "Small Pipe Sewers." Secy., S. E. Tinkham, City Hall.

Ohio Institute of Mining Engineers.—Summer meeting at Logan, O., July 11, 12, 13. Pres., W. H. Jennings, Columbus; Secy. R. S. Weitzel, Kittanning.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

A CURIOUS illustration of the hap-hazard and hasty way in which the Panama canal work has been conducted is the form of the rail section used for the construction tracks. About 1,000 miles of this rail are on the ground. It is of 70 lb. section, which is needlessly heavy to begin with, and ill suited for construction tracks, but the form of the section makes this evil still worse. Instead of following the time-honored practice of American railways, to make the base equal to the height, which is a sort of survival of the fittest from long experience, this rail is made 5 ins. high by 3¾-in. base; fully ¼-in. higher and ¾-in. narrower than such a rail would be if designed here. It is easy to guess the motive: Some gifted mind reasoned out that the principal strains were vertical, and that greater stiffness would be obtained with base enough in proportion for the overturning moments. This was done long ago, in fact, on the continent, where all rails of the American or flat-bottomed type are rolled higher than here. On well ballasted and well cared for permanent way no great harm has resulted, possibly.

But on the rough construction tracks of the Panama canal, much harm has resulted. The locomotives are heavy and have rigid wheel-bases; the ties are not always of the best, and the line and surface often of the worst, and the result is that it is very difficult to keep the rails to gauge, and that derailments are unpleasantly common, which may be directly traced to the form of the rail.

THE most important financial event which has occurred for a long time is the placing of $36,860,000 of the new Reading bonds with a syndicate including seven or eight of the heaviest banking houses in London and America. Of these new securities, $24,860,000 draws 4 per cent. interest and $12,000,000 is in first preferred income bonds and draws interest at 5 per cent. if earned. The former were sold at 87½ and the latter at about 75. The bonds to be retired by this issue drew 6 or 7 per cent. and the saving to the company in fixed charges will be most gratifying to those who have all along believed in Reading as a future dividend payer. The whole amount to be issued is nearly $100,000,000 and the successful floating of the whole loan is now everywhere acknowledged. The effect upon our American bond market will be most thoroughly gratifying to all projectors of new enterprises, as the influx of so large an amount of foreign capital sets free a like amount on this side to seek remunerative investments.

THE daily press has again exhibited its profound gullibility where important railroad matters are concerned by giving wide circulation and extended space to the story that the Pennsylvania had "gobbled" the Baltimore & Ohio's Philadelphia extension and Schuylkill River East Side Railroad, and to the still more sensational and absurd report that the Pennsylvania was negotiating for the purchase of the whole Chicago, Burlington & Quincy system. The sole foundation for the last story seems to have been a trip of General Manager MCCREA of the Pennsylvania to Omaha and Denver.

This is a long way ahead of MARK TWAIN'S first achievement in collecting news for the Virginia City *Enterprise*, when from one load of hay drawn by a sickly burro he invented a half a hundred loads and created such an excitement in the local market as had never before been known.

THE recent Russian railway movements are very important. A few days since the new railway through Merv, Askabad and Bokhara to Samarcand, just north of the Afghanistan frontier, was opened, materially improving the chances of Russia in any conflict with England in Afghanistan and northern India. The route now runs from St. Petersburg and Moscow south to and over the Caucasus mountains to Baku on the Caspian sea, thence by steamer to Ossoun Ada and thence by the route above to Samarcand. The mountain section over the Caucasus, which is not yet completed, passes over a summit 8,000 ft. high, or some 2,000 ft. higher than the Alpine railway lines and is said to be of the wildest and most interesting character.

But important as this line is, especially in a military point of view, as an engineering enterprise, it sinks into insignificance in comparison with the great line over 5,000 miles in length, extending from St. Petersburg and Moscow entirely across southern Siberia to Vladivostock, on the Sea of Japan, just north of the Chinese boundary, passing through Ekaterineburg, Tobolsk, Tomsk, Chita, Nerchinsk, etc., or just north of the Chinese frontier and through the most densely settled part of Siberia, now largely given over to penal settlements. The map given in the May *Century*, showing the route followed by Mr. GEO. KENNAN in his Siberian travels, shows also very closely the route of this railway—closely enough at least to give a clear idea of its general character—except that it stops about 2,000 miles short of the destination on the coast. This line is to be put through as an imperial enterprise, and hence is likely to be constructed pretty rapidly, and it is now announced, on what seems to be imperial authority, that the whole Siberian exile system is to be shortly abolished, and Siberia thrown open to industrial settlement. It is a rich country, and the portion pierced by the railway is no further north than England, and has a tolerably favorable climate. The effect upon China if this railway is constructed cannot but be great. A branch of 1,000 miles or less will extend to the Yellow sea through Pekin, and 500 or 600 miles further will reach to Shanghai.

THE *Springfield Republican* quotes our criticism of the proposed new stone arch over Main St. in that city, illustrated in our issue of May 12, and declares nevertheless that "the stone arch as originally designed is graceful and ornamental", declaring likewise that our criticism was merely as to the height of the parapet. It is true that our words might be twisted into that sense, since we did not enter into details, but the context made sufficiently clear what was regarded as the particular way in which the high parapet was offensive; viz. in its *irregular* height or crowning in the center by an unmeaning and decided curve, which is contrary to all the accepted canons of design for such structures, the parapet being 5 or 6 ft. higher in the center than at the ends. This may possibly have been done with the intent of more completely hiding the trains at the center of the arch where the roadway passes under, and so have an element of utility to excuse it, but the same end can be accomplished more appropriately in other ways leaving the main parapet lines of the structure horizontal, as they should be; and the bad effect is intensified by the row of 24 little windows directly under the parapet and also on a curve, which are absolutely unmeaning and senseless, since the structure is palpably not a residence nor for look-out purposes, while they add greatly to the cost.

It may appear to an architect that graceful effects cannot be obtained in a structure without windows, even when it is merely a stone arched bridge with no one to look through the windows except passengers in the trains, but it is not so understood by engineers; and when these windows are for the most part sunk below grade, and thus mere shams even as windows the effect is additionally unpleasant. But if the design pleases the people of Springfield and the officers of the railroad no one else has a right to object, since "there is nothing either good or bad but thinking makes it so", and they are the ones who will chiefly have to look at the bridge.

WE have received three subscriptions aggregating $35 in response to the appeal for the family of Mr. KUTTER, author of Kutter's formula, which appeared last week. We understand there are some others likewise, made to other parties, which have not come to us. We trust all our subscribers will open their hearts, and send in any sum from $1 to $20 which they may feel they can spare in so

good a cause. Mr. KUTTER was an able engineer; he rendered great services to science, which have been of great pecuniary value to hundreds of enterprises; he had always but a small salary, and now leaves a large family in destitute circumstances; a dollar sent to Switzerland is worth fully $5 to be spent here for a family so situated, and a few hundred dollars would be of the greatest aid to Mrs. KUTTER. We trust every engineer who is doing well himself will spare a few dollars for a family so situated, and next week shall hope to make acknowledgement of a considerable list.

The Status and Prospects of the Panama Canal.

Every engineer who has wondered what the real truth was as to the Panama canal will, we are sure, examine with great interest the very full information we are enabled to give this week. Interviews and statements have large elements of doubt about them, but photographs and progress profiles tell their own story, and the definite evidence of this kind which we give is the first of the kind which has been published in either hemisphere, so far as we know. But to understand it fully, and to appreciate its full force, we must have in mind the past history of the Panama canal, and to appreciate and weigh that fully, it is at least highly desirable, to have in mind the main facts in regard to M. DE LESSEPS great prior work, the Suez canal. We will therefore first summarize these facts briefly.

The Suez canal is 160 kilometers long, through sand throughout, with only a single kilometer having more than 50 ft. cut above the water level, and with only about 10 kilos. exceeding 30 ft. cuts. More than half its length was through marshes and lagunes, requiring only dredging, and fully a quarter was through the beds of ancient lakes where the surface was so far below the sea-level that little or no dredging was required. We have roughly taken off from the profile the following little table to show these facts more in detail:

	kilos.	p. c.
Surface at or near sea-level	86	54
Surface about 15 ft. below sea-level	21	13
" " 30 " " " "	18	11
Surface 10 ft. or more above sea-level	35	22
	160	100

As a whole, the average surface level was rather under than above the level of low water in the Mediterranean. The problem was not complicated by any natural river channels crossing or interfering with its route. A navigable canal had been made along the same route 2,400 years ago, by the Egyptian monarch NECO. The climate is not unhealthy. The work was begun in 1859, with $20,000,000 on hand, and the canal was opened for general traffic late in 1869 (vessels passed through in 1865) with a channel 20 ft. deep by 72 ft. bottom width, at a total cost of some $95,000,000, as against the original estimate of $32,000,000 (or $40,000,000 in all, including payment of interest out of capital during construction) for a bottom width of 144 ft. To obtain this latter width, $40,000,000 additional has been required. The total excavation up to 1870 was about 61,500,000 cu. m. (80,000,000 cu. yds.). The estimated tonnage of 6,000,000was not reached till 1884. The work was comparatively a very simple one. Nevertheless it was violently opposed and denounced as impracticable by various prominent English engineers, impeded by diplomatic intrigues of the English Government of a very questionable character, and discouraged by strong opposition otherwise. Almost immediately, however, it proved extremely profitable; traffic increased rapidly, and with tolls of $2 to $3 per ton on 5,000,000, to 6,000,000 tons, it has been able to pay 16 per cent. on capital; and shares which had cost $1,000 rose to $7,600. The present tolls are $1.80 per ton.

To these latter facts in regard to the Suez canal (great success after strong opposition and much ridicule) it is undoubtedly due that the Panama project has been able to get along thus far so well as it has. The more it has been denounced as impracticable and visionary, the closer has seemed the parallel with Suez to the unthinking populace, and the readier they have been to believe that the parallel would continue to the end.

The "International Congress" for the Panama canal was held in 1879. Its result was a foregone conclusion and its "deliberations" a farce. It found in favor of Panama. The estimated cube then was 46,000,000 cu. m. which was increased later to 75,000,000 and 105,000,000, and still later, 1885, to 151,000,000, of which 20,000,000 was for "derivations". How nearly even this volume approaches to what would be necessary to complete a sea-level canal may be in part estimated from the following data, showing how many cubic meters are represented by the work so far done, as shown on our profile:

The officially reported volume of excavation in cubic metres (1 cu. m. = 1.31 cu. yds.) and the officially reported *cash* expenditures (not counting discount on securities) have been as follows, taking 5 fr. = $1:

Year ending June	Year.	Expenditure Total to date	Cu. M., 1 = 1,000 Year	Total to date.
1881	$8,558,000	$ 8,558,000	——	——
1882	21,566,000	30,124,000	——	——
1883	15,617,000	45,741,000	1,104	1,104
1884	25,059,000	70,800,000	5,500	6,604
1885	26,261,000	97,061,000	7,659	14,263
1886	30,849,000	127,910,000	10,499	24,762
1887	25,000,000*	152,910,000*	12,413	37,175
1888	25,000,000*	177,910,000*	12,000*	49,000*

*These latter figures are estimated, for lack of exact data, since they extend up to the date of this issue of ENGINEERING NEWS. They probably are too favorable to the canal, rather than otherwise.

These figures show that, neglecting the $45,741,000 of expenditures in the first three years, for which there was only 1,104,000 cu. m. of work done to show, the cost of work per cubic metre was in 1884, $4.56, in 1885, $3,43, in 1886, $2.94; the total cost of the work executed to that date, 24,762,000 c. m., being $5.17 per cu. m.

Passing without discussion the question of what the total cube of the sea-level canal would have been when the part so far done represents 49,000,000 cu. m., and considering the cost per cubic metre; is there anything in these figures to encourage a belief that the remainder of the work can be executed for less than $3.50 per cu. m.? We think not. Experience will, or ought to, lead to greater economy, but on the other hand the work so far has been skimmed, the softest spots have been picked out; the cube has been swelled by an immense amount of dredging in soft earth and by a large amount of mere surface stripping; most of the parts which are likely to be washed out by the Chagres, and have to be done over and over again, are still barely begun; the cost per metre is sure to increase as the cuts grow deeper. The profile we give bears the clearest evidence to all these facts; the climatic difficulties at Panama are great; the management wretched. Therefore, it seems to us, the future work is far more likely to run above than below the price named.

The total capitalization of the company, to date, is as follows, taking the franc at 20 cts.:

			Par Value.
Original shares			$60,000,000
Loan of		Floated at par.	
1882, 5 per cent.		12.5 per cent. disc.	25,000,000
1883, 3 "		43. "	60,000,000
1884, 4 "		33.4 "	34,129,200
1885, 4 "		55.4 "	6,837,500
1886, 3 "		55. "	21,760,400
1887, 3 "		56. "	31,777,400
1888, 3 "		" "	21,646,400
Total par value			$251,150,900
Lottery loan, just authorized			144,000,000

The total cash product of these loans was about $170,000,000, or a little less than the amount given above as expended to date, which is doubtless substantially correct.

The later loans have all been obtained by expedients and promises of a desperate nature, which we cannot again go into in detail, as they have all been described in past issues, but which, if fulfilled, would forbid that any appreciable sum should be diverted from the bond-holders to the actual work of construction. The fate of the lottery loan remains to be seen, but it is reasonably claimed that if its conditions are fulfilled there will be little left to devote to the work of actual construction, even if it should be finally floated.

Of the total expenditure up to June, 1886, there had been expended, according to the inventory for 1887:

Purchase of Panama Railroad and Canal franchise, etc.	$18,775,600
Offices, barracks, furniture, etc.	6,015,600
Plant and stores	18,371,120
Works and administration on the Isthmus	47,442,440
Administration, interest, etc.	32,429,840
	$123,034,600

The realizable assets, in the form of plant, etc., were returned at this date at some $25,000,000, and they certainly have not increased since. The total expenditures on excavators, locomotives, and contractors' plant have been some $16,400,000, the steam power representing 52,400 H. P. The original estimate for the Chagres dam, tide-locks, light-houses, and other works yet untouched, was $16,400,000. The plan for the Chagres dam has since been much cheapened. Whether the cost of the completed work has been cheapened remains to be seen.

So much for the record of the actual course of events to date; let us see now what have been M. DE LESSEPS' promises and statements:

In the Congress of 1879 he declared repeatedly that the Panama canal was easier to build and maintain than the Suez, which may be passed as mere hopeful talk; but he repeated this declaration in 1884, and stated that the canal would "be ready by Jan. 1 1888, and so late as 1886 declared repeatedly and formally that the canal *without locks* would be opened in 1889, and at a total stock cost of only $120,000,000. Last November the declaration was made that the canal would be open "Feb. 3, 1890", still without locks. Today, it is a few months later, with locks. The proposition to "open" the canal with "temporary locks" was only broached some eight months since.

In attempting to weigh the probabilities as to the future, under the vastly simpler conditions of the lock canal, the first fact to be taken into consideration is that the unsupported declarations of the Company as to the time, money and work required to finish the lock canal are not entitled to the least consideration, because we have only to glance at our sea-level profile to see that it must have been known to them for years that the construction of the sea-level canal was an absolute impossibility in a practical sense, as it has been believed to be by engineers almost from the beginning. That is to say: with time and money enough, nothing is impossible; but not one-tenth of the work has yet been done, which would be required to open the sea-level canal, and possibly not one-twentieth of the money spent. We can only escape from the conclusion that this has been known to the management for at least three or four years by assuming colossal ignorance, and either horn of the dilemma is equally fatal to their credibility.

The worst feature of the profile, to those familiar with the proper conduct of public works, is not so much the small aggregate of work done, but the distribution of it, in the

damning evidence it bears that all has been done for theatrical effect, to facilitate "raising the wind" by producing an impression on the ignorant and unthinking, rather than to so conduct the work as to complete it in the least time at the least cost. The worst feature of all is the "completed section." It has been much pointed to as evidence of progress, although, it is not yet "completed" either on the bottom or the slopes, but if the work had been conducted with intelligence and good faith, it would not yet have been touched. There happened to be this 10 miles or so of easy dredging, comparable to 10 miles of easy surface grading, approaching to 50 miles of heavy mountain railroad work. What would be thought of a contractor for such a work, who should first attack the light end of it, finish it up quickly, and then announce with a flourish of trumpets that he had "10 miles already graded", when he had barely scratched the heavy work? Yet such policy was much worse on the canal than on a railroad contract, because it compelled many years of interest and maintenance charge, doubling and trebling the total cost, which might all have been saved by postponing this perfectly simple and determinable fragment of the work until it was necessary to begin it in order to complete it simultaneously with the heavy sections.

Similarly, the Gamboa dam and the deviations of the Chagres, which have hardly been begun to-day, should have been the first work started, and should have been completed before any work was done on the parallel section of the canal proper. It was the most dubious problem of all, and any errors, if committed, would then not affect the canal work proper. By confining the whole work on the canal for two or three years to a comparatively small working force and expenditure on the Culebra cut and the Chagres work, the ultimate opening of the canal would not have been postponed a day, the force would have been gradually organized and broken in, plant could have been brought gradually and intelligently, and enormous interest and maintenance charges saved. Any contractor in his senses would have done precisely this, but it would not have tended to fire the French imagination with reports of progress; failures with the Chagres might have thrown cold water on the enterprise and frightened investors by the cost—and it was not done. Ground was broken in as many different places as possible; the hard and doubtful work was skipped, and the easy work only pressed.

These eccentricities of management are likely to continue, for they are even more necessary now than before, and they seem in part to spring from national peculiarities. Therefore, remembering in how many ways the conditions for economical management are unfavorable, and that 35,000,000 to 40,000,000 cu. m. is admitted to be still required for the lock canal, which we have shown elsewhere is likely to be at least 50,000,000 cu. m., it appears to us that the most favorable showing which can be made for the completion of the lock canal in four years, or by June 1, 1892, would be as follows:

50,000,000 cu. m. excavation at $2.50 cash	$125,000,000
Lock system complete, as per EIFFEL contract	25,000,000
Contingencies, washouts from Chagres, administration and interest charges, etc., at $20,000,000 per year	80,000,000
Total minimum cash outlay	$230,000,000
Against cash outlay to date for work done	177,810,000

To raise the last mentioned sum has cost on an average about $2 for $1. The least probable rate for future obligations is $2.50 to $3 for $1, which would require at least $500,000,000 of obligations in addition to the $351,000,000 which now exist, to complete the work. Wiping out all the latter, as may yet be done, there would still be $450,000,000 to $500,000,000 of obligations to float, in all probability; for the credit of a new company would certainly not be very high. Every one who now invests intelligently in the company does so with the strong probability of having to share the profits of his investment with this amount of new securities, besides those which now exist.

Considering that the weakest lambs have been already bled to the tune of $170,000,000 of hard cash, is there anything in these figures which is likely to be particularly alluring to the warier lambs who are still unbled? To see this, let us consider the probable traffic. M. DE LESSEPS now figures on 10,000,000 tons per annum at $3 per ton, against $1.80 on the Suez canal; but this is more than double the original estimates, and assuredly beyond reason. To see what are the real possibilities, we may take an estimate of the traffic now "in sight", which originally appeared in the *Evening Post*, for the probable traffic of a Nicaragua canal. As this has been republished by the Nicaragua Canal Co., it undoubtedly is about as high as they think it reasonable to claim, and it is likewise somewhat higher than the estimate of the Bureau of Statistics:

Class of Trade.	Tons.
(1). Present trade across the Isthmus	1,217,685
(2). Trade between Atlantic and Pacific ports of United States	145,713
(3). Trade between Atlantic ports of United States and foreign countries west of Cape Horn	752,585
(4). Trade between Pacific ports of the United States and foreign countries east of Cape Horn	879,844
(5). Trade around Cape Horn of European countries	1,471,369
(6). Trade of British Columbia with Europe	39,818
Total tonnage in sight	4,507,044

This is counting all the traffic of the above classes which now exists as divertable to the canal. Perhaps it is, and perhaps by 1892 it might amount to 5,000,000 or 6,000,000 tons, but this would be only $15,000,000 to $18,000,000 gross revenue. It was not till 1881, 12 years after opening, that the gross receipts of the Suez touched $10,000,000.* The maintenance and operating expenses of the Suez are not much over $1,000,000 but as they would be sure to be larger at Panama the above sums would not go far toward paying such interest as investors in a hazardous enterprise would expect, even if the threatened construction of a canal at Nicaragua or ship railway at Tehuantepec should not take place.

As a whole, therefore, our belief is that the Panama canal has come very nearly to the end of its rope, even on the lock basis, and that it is not likely to be completed by the present Company at least.

Foreign Technical Education.

It is a question frequently asked whether it is worth while any longer to send young men desirous of an engineering education to the European colleges. Some years ago this question was a very natural one, because our own preparatory and technical schools were then greatly inferior to those of Continental Europe, where students not only devote more time to the study of their preferred branches, but where the education was made much broader, by embracing a number of scientific and literary subjects intended for the general cultivation of the mind; yet, formerly, perhaps dispensable in our essentially practical life.

The European colleges are either richly endowed or otherwise supported by the Government. The professors are selected from the ablest men in the country, and in the universities at least are given full liberty regarding the subjects they wish to teach and the manner of teaching them. We, therefore, find a large number of special subjects very fully treated in details; particularly in the directions where constant progress is being made, many of the professors being original workers. The student also has great liberties. At the beginning of the course he chooses the lectures he wants to hear, and the practical work he wants to do, a great deal of which is optional, but on most of which he is obliged to pass an examination, if desiring a degree. Every opportunity is given him for perfecting his knowledge in the direction he may select, and a minimum amount of control or compulsion is exercised. The age at which students are admitted in most of the colleges and universities is from 17 to 18 years.

It was formerly different here. Our colleges were mostly dependent upon contributions and fees, and, as our boys were usually anxious to finish their education as rapidly as possible, the college admitted students at an earlier age, and narrowed the curriculum as far as practicable and made all studies compulsory. A barely sufficient training for a certain pursuit was thereby given at a minimum expense. Under such limitations the teaching as a rule could not be of the best.

But time has changed all this. Many of our technical schools are now well endowed, and some also receive State appropriations, making them more independent and able to furnish better instruction and on a broader basis than formerly. Our technical schools now have among their professors some of the ablest men in the country, and their laboratories, shops and practical training are, in some instances, superior to what is offered in Europe. The facilities for acquiring technical knowledge are therefore now fully as great in this country as they are in Europe, and we do not think it necessary, nor even advisable, to send young men abroad for a technical education.

The solution of practical questions is generally quite dependent upon the customs of the country and of the people. An American preparing for his practical work in Europe will not be nearly as well prepared by study there to cope with the problems which will actually come before him in after life, as if he had studied at home. A mechanical engineer in Europe often uses entirely different tools and machinery, and has different methods of working. If an American studies on the Continent, he will learn all the technical terms of his profession in a foreign tongue, and will be compelled to learn them all over again later, with no little difficulty and possible mortification. Similarly with the civil engineer. He is sure to imbibe different ideas about building and operating a railway, and even waterworks, from what he would at home, and he must first unlearn these if he wants to succeed at home. He also learns different methods of bridge construction, different details of practical architecture, of mining and of other technical specialties, which it is, of course, well to know about if it is *in addition* to similar knowledge of home practice, but which should not be given so much of the student's

*The increase was very slow and steady as follows:

Year	Ships	Tons	Receipts
1870	486	436,609	$1,031 865
1871	765	761,467	1,798,746
1872	1,082	1,100,143	3,281,518
1873	1,173	1,367,767	4,879,465
1874	1,264	1,631,650	4 971,476
1875	1,494	2 009,984	5,777,260
1876	1,457	2,006.771	5,944 599
1877	1,663	2,355,447	6,554 868
1878	1,593	2,269,678	6,219,645
1879	1,477	2,263.332	5,937,212
1880	2,026	3,057 421	8,364.179
1881	2.727	4,136,779	10,935,238
1882	3,198	5,074,808	12.681,916
1883	3,307	5,775,861	13,702,413
1886			11 359 657
1887		6.458.375	11,625,075

The slow growth shown was largely because there were then few steamers in existence capable of using the canal, an obstacle which no longer exists.

time as the American studying abroad must give when he will be obliged to practice his profession in another country from that where he obtains his education. We believe, therefore, that the proper education for an American engineer should include, as the first essential, a full and complete course of study in one of the home colleges. If he then feels desirous of further study rather than of immediately entering on practical work it will undoubtedly be of great benefit to him, subsequently, to spend one or two years in Europe studying further facts and methods of the particular branch he desires to follow, and wherein he may find himself and, perhaps, also our colleges, deficient. After graduating here he is far better fitted to know what further detailed studies will suit his taste and be of advantage to him at home, and is therefore better able to make a wise selection from among the great number of special subjects taught in the European colleges, and so obtain, in a year or two, more solid benefit than he could in a whole course otherwise.

Not the least reason for this conclusion is that a few years in a foreign country at such times will always benefit a student greatly indirectly, by broadening his horizon, by observation, enabling him to recognize in what direction we may profitably copy from foreign practice, or at least, to see that there are more ways than one of getting the same result. Again by becoming familiar with at least one foreign language, either French or German, he will have a fund of knowledge opened to him, which sometimes is of the greatest importance when studying up certain engineering questions, requiring more facts and more experience and opinions than are presented in the English literature alone.

It would be much better in the end, we believe, if the requirements for admission and the course of study in our technical schools were so regulated that sufficient familiarity with both French and German to read technical matter fluently were secured to the graduated C. E. or M. E. Certainly one of these languages ought to be mastered to this extent, and it does not necessarily take a great amount of time to do so. There is, indeed, scant time to get through with the full curriculum, as it is, but it had better be abbreviated in some other direction than not to do so, whether the question be looked at from the purely practical standpoint of which use of the time will pay the best, or from the juster one in the end, of which will tend most to broaden the student's horizon and fit him intellectually for his future work in life. Moreover, the study of foreign languages calls such different mental faculties into play that, to a large extent, it is a relief from more serious studies and will not require less of them. We speak with full remembrance that most of our prominent technical schools have French or German, or both, in their course, but we also remember that it is studied to so little purpose that there is not one of them which ensures the very moderate mastery of either language which we suggest, and which demands vastly less time than to master a language so as to be able to speak and write it well. Were this done by our colleges one of the strongest arguments in favor of young men studying abroad would be done away with.

From what we know of the personnel of the profession, however, we are forced to the conclusion that a year or two of study abroad is a most paying investment, and that even the student who gets all his professional education abroad is at least under no great disadvantage. A chief reason for the latter is, however, that from the very fact that American and foreign practice differ widely in many details the student is in effect compelled, "willy-nilly", to continue his studies after graduation, and thus to a large extent master the practice of both countries as well as the language. That there are any longer material direct advantages in the management and organization of foreign schools as compared with our own we do not believe, and therefore we are satisfied that the greatest advantages to be had by Americans from foreign schools is in a year or two of post-graduate study. It is hardly too much to say that the only real and lasting benefit which any school confers on any student is to teach him to think, and to know where to find knowledge when he wants it, and that this is done more effectually and thoroughly abroad than here we very much doubt.

PERSONAL.

W. P. HOMAN, General Manager of the St. Louis, Arkansas & Texas R. R., has resigned.

WM. SEMPLE, a Director of the Pittsburg & Western Ry., has been appointed President of the Pittsburg Akron & Western Ry., to succeed LEWIS MILLER.

JACOB JOHANN, Superintendent of Motive Power of the Texas & Pacific R. R., has resigned his position.

L. B. ROCK, who recently resigned his position as Superintendent of the Northern Division of the Chicago, Milwaukee & St. Paul Ry., died May 28, at the age of 63.

HENRY C. BRUNDAGE an architect, committed suicide at Dunkirk May 23, by shooting himself through the head. The papers state that he was the designer of the original Portage bridge on the Erie Railway, which is not true, Col. SILAS SEYMOUR having been the engineer and designer. Mr. BRUNDAGE may have been a draftsman or assistant on the work.

Triple Expansion Engines for Lake Service.

The March issue of the *Journal of the Association of Engineering Societies* contains a paper by WALTER MILLER, member of the Civil Engineers' Club of Cleveland, in which he points out the strong tendency toward higher expansion ratios, and describes several types of triple expansion engines which have rapidly come into favor for marine work.

It is only about 4 years since Mr. KIRKE of Glasgow designed the first triple expansion engine, which was for the steamship *Aberdeen*, and now this type of engine has almost superseded the double compound engine in that country. On the *Aberdeen* the saving in fuel, and consequent increase in carrying capacity, was 500 tons per voyage. Mr. MILLER predicts that in a very short time the quadruple expansion engine will supersede the triple expansion engine for lake service.

With triple expansion engines using as they commonly do steam with an initial pressure of 150 lbs. per sq. in., it is important that the valve gear and valves should be well designed. It is customary to use a piston valve on the high pressure cylinder, a single ported slide valve on the intermediate cylinder, and a double ported slide valve on the low pressure cylinder. Though many designers consider it imperative to use piston valves on the high pressure cylinder, and some even on all the cylinders, experience has proved that slide valves made of good hard iron, work as well, and are very much cheaper and easier to repair. The use of piston valves necessitates excessive clearance, and two valves are required for the low pressure cylinder.

Many styles of reversing gears have been used by Scotch and English engineers, among them the Joy gear and several single eccentric radial gears, but in this country, with one exception, the link motion has been used, and when correctly suspended it gives very satisfactory results. With the Joy gear it is possible to have the steam chests in front and easy of access, but wear will be excessive unless a piston or some other balanced valve is used. The most common method of arranging the cylinders is to put them side by side. One firm puts the intermediate pressure cylinder between the high and the low, and uses slide valves on all the cylinders. This arrangement permits six journals of equal length in the bed plate and a crank shaft made in three interchangeable parts is used. The same arrangement of cylinders is used by another firm but with the valves so arranged that the intermediate and low pressure cylinders are brought close together. This gives five journals in the bed plate and a crank shaft in one or two parts. In another arrangement the high pressure cylinder is placed between the other two, and is provided with a piston valve and Joy valve gear, while the slide valves on the two larger cylinders are fitted with link gear. This arrangement admits of four journals in the bed plate and crank shaft in one piece. The objections to this arrangement are: the two valve gears, requiring two different motions to reverse; the journals are of different lengths, and hence will wear unequally; a shaft with three cranks made in one piece is difficult of construction and very costly to repair; having the high pressure cylinder in the middle necessitates a long, wasteful and unsightly series of pipes to get the steam from the intermediate to the low pressure cylinder.

Still another arrangement of cylinders is to have the high pressure and intermediate pressure cylinders tandem and the low pressure cylinder beside the intermediate. The principal objection to this plan is that it throws too much work on one crank pin, and makes a very unequal strain on the crank shaft.

Designers endeavor to have about the same amount of work done in each cylinder. The exact ratio of cylinders is a matter requiring close study as the volumes of connecting pipes and all clearances have to be considered.

Crank sequence admits of some variation. With low pressure leading, intermediate following, and high pressure last the back pressure occurs through about one sixth of a revolution. With high pressure leading, intermediate next and low pressure last the back pressure would continue through one-third of a revolution.

The increased steam pressure has caused the abandonment of the return tubular fire box boiler, with its large crown sheets and flat stayed surfaces, and the substitution of what is called the Scotch boiler, with circular furnaces and return tubes.

The furnaces are either corrugated or flanged in short lengths with rings between flanges. Some of these boilers are 14 ft. in diameter, 12 ft. long, with shell plates 1⅛ ins. thick, and are capable of carrying 160 lbs. per sq. in. steam pressure.

The Quality of the Croton Water.

Dr. JOHN C. PETERS delivered an address on Apr. 28, before the New York County Medical Society making some surprising and sweeping statements.

He stated that the sewage created by 25,000 people the largest condensed milk factory in the world, 10,000 cows, 1,200 horses, 1,500 hogs, and 40 factories, was all being run into that body of water from which the city of New York draws her supply for domestic purposes, and continued:

"Tons on tons of refuse and filth are daily run into Croton Lake, contaminating the water and rendering it poisonous to the million and more people who drink it. At one time New York scouted the idea of people drinking such water as that of the Thames, from which river London draws her supply, but, while in former years London water contained five times more bacteria than New York water, recent investigations show that in one cubic centimeter (one third of a teaspoonful) of the water of four different cities, that of Boston was found to contain 43 bacteria, that of London 44, that of Berlin 99, and that of New York 526. While, of course, the greater part of these are the common, harmless water bacteria, still there is a large proportion which are cast off by the germs of disease, and these lurk in the water and breed, to be consumed by the population of New York City. The evil is a constantly growing one, as the railroad companies and enthusiastic real estate speculators are continually striving to build up towns and resorts in the vicinity of Croton Lake, all of which drain into that sheet of water. That the foulness of the water is not more noticeable is due to the extent of the lake, which allows the filth to become partially absorbed, but the disease germs still remain."

The doctor believed that a great deal of the scarlet fever, diphtheria, cholera, and other malignant diseases, of which New York is having her full share might be traceable to this cause, and that though no diseases were ever attributed to drinking water in this city, many epidemics in Europe had been, and, why, the doctor asked, was it not likely that drinking water so impure as that of New York should be responsible for similar troubles here?

We are unable to believe that the appalling bacteria statistics above, truly represent the case; but there can be no doubt that the growth of population on the Croton water-shed is injurious to the purity of the water supply, that it will continue to increase if permitted, and that while it is hardly feasible to make a complete wilderness of so large an area, it might in the end be cheaper and better to do so, to the extent of positively prohibiting all manufacturing, and growth of villages and towns requiring a sewerage system of any kind or form.

In our issue of May 19, we noted the extremely low salaries offered to engineers and assistants in India. Some advertisements appear in *The Indian Engineer*, in which the Chief Engineer and Government Secretary, for "H. H. The Nizam's P. W. Dept., Hyderabad-Deccan", whatever that is; asks for surveyors, assistants, etc. in the irrigation department, which show how such men are paid in that country, taking the rupee at 36 cts. gold: Assistant Engineers, $108. to $144. per month and traveling allowance $39. Supervisors, $18. to $54. traveling allowance $18, Surveyors, $18. traveling allowance $9. Draughtsmen, $16.20, traveling allowance $5.40. These appointments are temporary, but may lead to permanencies. The applicant must be provided with testimonials, references, etc., and state age, experience, nationality or caste.

The Bengal-Nagpur R. R. wants a head draughtsman, familiar with the management of an office, at a salary of $72 per month.

CORE FOR HOLLOW TILES.—A sectional core to be used in the manufacture of cement conduits for underground wires, or for making any kind of cement tubes, has been invented by P. R. GREENE. There is a central plug or core of wood or other material, around which is a brass shell in three longitudinal sections, one of which is wedge shaped and has the sides beveled to lock with the beveled sides of the adjoining sections. When the cement has set, the central core can be driven out and the shell removed without injury to the pipe. Sample tiles can be seen at the office of JOHN CLAFFY, 48 Dey St., New York.

THE extent to which a township may obstruct a highway when undergoing repairs was defined by Judge MACMAHON in Canada in the case of McDONALD vs. the Township of Ekfrid, Ont. A heap of gravel about 2½ ft. high and 7 ft. long had been placed on the highway where it had frozen. A fall of snow obscured it, and in driving over it Miss McDONALD was thrown from her carriage and was slightly injured.

The first jury in the face of a very strong charge to the contrary by Judge ROSS found a verdict for the Township, but in a new trial a verdict was rendered in favor of the plaintiff. This means that under no circumstances has any one a right to place dangerous obstructions on the highways.

COLORADO is now producing 300 barrels of petroleum per day, sufficient to supply that and the adjoining States and territories, the value of the annual production being about $500,000. Four years ago not a barrel was produced, and now only one field is developed, that in Tremont county; but it is predicted that within a year the daily production will reach 1,000 barrels.

PUBLICATIONS RECEIVED.

Steam Boilers Practically Considered.—A pamphlet issued by the POLE Engineering Co., of St. Louis, Mo. The most useful parts of the contents are the tables of specifications for different classes of boilers. There are also tables of safe working pressures; heating surface; pressure, temperature and volume of steam, and data relating to chimneys. The Standard rocking and the Sheffield grate bars are illustrated. A page each is devoted to form, materials, brands of iron, and strength, and 2 pages to construction.

CORRESPONDENCE.

Retracing Old Compass Lines.

SAVANNAH, Ga., May 26, 1888.

EDITOR ENGINEERING NEWS:

I wish to retrace a line run with the compass in 1854, or any other year in the past, in this locality. Now I want to know what the variation is in the magnetic meridian, at this date and at the date of the original survey. To know this (supposing I cannot get two points on the line,) I must know what the variation was at the date of the original survey, and what it is at this date, between the true and magnetic meridians. I have, or would have, no trouble, I suppose, in ascertaining the variation of the needle at this date, but what it was at the original, or date of the original survey "sticks" me, I am totally adrift. Can you help me? It may be an unpardonable piece of ignorance on my part, but what I have read on the subject leads me to believe it is no simple matter. I have a little book on "Magnetic Variation", by I. B. STONE, formerly instructor in the Sheffield Scientific School of Yale College, but his tables are way back in 1840, etc. Has he a later edition? Do you know of some good, reliable and practical work from which I could ascertain the desired information? D.

[If our correspondent has STONE's "Magnetic Variation" he has all that is necessary to retrace with great exactitude any old line, the date of which is known. A map giving the lines of equal magnetic variation for the United States, such as he will find in GILLESPIE's "Surveying", and various other books, or such as will appear, if he waits a little longer, in ENGINEERING NEWS, may also be convenient. He can find in "Magnetic Variation" the variation at a given date and rate of annual variation for the place he desires and many others in the vicinity. From this he can compute what should be the variation today and check it by an actual determination of the present variation by a north and south line. If it does not check he can correct back. The superintendent of the Coast Survey may, on application, be able to give still more exact and recent data, but by taking sufficient pains, from the data given in the above book alone, the probable difference of variation at any two given dates can be worked out very approximately after determining the actual variation today. It is a mere matter of laborious but simple figuring and care. LOOMIS' "Practical Astronomy" is, perhaps, as good a book as any from which to study up the methods of determining latitude and longitude.—ED. ENG. NEWS.]

Positions on the Panama Canal.

JONESTOWN, May 21, 1888.

EDITOR ENGINEERING NEWS:

Will you be so kind as to inform me to whom I should apply to secure a position as leveler on the Panama canal, and what would be the chance for getting such a position, and greatly oblige,

A YOUNG ENGINEER.

[The chance for getting such a position would be excellent, as "few die and none resign" does not apply to the Panama canal. A great many die and nearly all the rest soon resign, but we have too much regard for "young engineers" to give them any aid and comfort in securing such vacancies.—ED. ENG. NEWS].

Crushing Strength per Square Inch.

CHAMPAIGN, Ill., May 29, 1888.

EDITOR ENGINEERING NEWS:

With no desire to be hypercritical, I wish to call the attention of your readers to a few points concerning the formula for the crushing strength of stone cubes in terms of the size of the test specimen, as referred to on page 402, and also page 430 of ENGINEERING NEWS. The formula was deduced as stated by the late Gen. GILLMORE and published in his "Report on the Compressive Strength, Etc., of the Building Stones of the United States", as appendix II. of the Annual Report of the Chief of Engineers for 1875.

According to Gen. GILLMORE's formula, the crushing strength per square inch of cubes varies as the cube root of the side of the specimen. A short time ago I made an exhaustive study of that subject in the most general way possible, not even limiting the form of the equation sought nor fixing values for the constants. I discussed experiments made by HODGKINSON and GILLMORE, and also those made with the United States testing machine at Watertown, Mass. The latter included tests on mortar of Rosendale and Portland cements, both neat and with sand, concrete and natural stones. If I were to present the vast array of figures and diagrams required, I think you would say the work was thoroughly done.

The conclusion of the whole matter was that the experiments show no relation between the crushing strength per square inch and the size of the cube. These experiments show that there is no appreciable difference in the strength per square inch for different sizes of cubes. For example, tests were made with the Watertown machine upon cubes of neat cement from 1 to 12 ins. in diameter, and there was a greater difference between the mean of the six experiments on each size than between the mean results for the different sizes. [This does not by any means prove our correspondent's conclusion, as he puts it.—ED.].

Gen. GILLMORE deduced his formula from two series of experiments made upon two samples of Berea sand-stone, the size of the cubes varying in one series from ¼ in. to 4 ins., and in the other from ¼ in to 2¾ ins. Unquestionably his formula correctly represented, with surprising closeness, the results of these experiments. However, nobody either before or since has ever made any experiments which conform to this law. HODGKINSON tested teak wood cylinders, ½ in., 1 in. and 2 ins. in diameter, the height in each case being twice the diameter, and obtained results which showed that the strength per square inch was independent of the bed area.

Although Gen. GILLMORE was a careful experimenter, there must have been some undetected source of error in his work. Possibly it was the friction of the testing machine.

The failure of the formula above referred to does not invalidate the essential features of the conclusions which you, Mr. Editor, drew from it. All experimenters agree that the crushing strength per square inch increases rapidly as the depth of the test specimen decreases; that is, the strength per square inch of a slab is much greater than that of a cube. The reason for this doubtless is that in crushing a specimen as high or higher than broad, the material near the center expands laterally more than that next to the two surfaces pressed and causes failure by tension perpendicular to the direction of the applied pressure. This is proved by the well known manner of failure of stones under compression. The reason for the greater strength of slabs is obvious.

The writer has sought to determine the relation between the strength of slabs and cubes, but an examination of the only experiments available fail to discover any simple relation between them. The writer would gladly make some experiments to determine this question, but the capacity of the University testing machine, 100,000 lbs., is too small for this kind of work.

IRA O. BAKER.
University of Illinois.

[Our correspondent's "conclusion of the whole matter" seems to us to be based on extremely slim evidence, far from warranting his conclusions. The tests on cement blocks might well be affected by the difference in the compactness and homogeneousness of the specimens and by the differing hardness of the skin and interior of the mass, which would tend to make the smaller specimens test higher in proportion. The teak wood tests are on a small scale, and moreover, no one has claimed that the law would extend to a fibrous material like wood. The GILLMORE tests were on a sufficiently large scale, and with sufficient uniformity in the results, to forbid any suspicion that the results were accidental, except on the strongest and clearest evidence, especially as they were made with two different stones, differing in strength as 7,000 and 9,500. This being so, the only evidence that is worth a copper in contravention of them is a series of tests of some other stone showing inconsistent results, for the same reason that the testimony of one man that he

has seen a certain thing is worth more than the testimony of a hundred that they have not seen it. It is surprising that there should be such a paucity of evidence on so important a question, but that does not warrant using imperfect evidence instead. The first question that should arise before accepting apparent evidence as real is: Does the apparent contradiction admit of other explanation than an error in either sets of tests? Most assuredly it does, and it appears to us, not only admits but demands it; but in either case our correspondent's conclusions fall to the ground until backed by indisputable evidence. ED. ENG. NEWS.]

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The Annual Convention at Milwaukee, will begin Thursday, June 28. Meetings for professional discussion and for the transaction of business, will be held on Thursday, Friday, Saturday and Monday.

Arrangements will be made for visits to points of engineering interest in the Northwest, the details of which are in progress and will be announced when perfected. It is expected that these will occupy the time till after Wednesday, July 4. The return from the Convention will probably be toward the close of the week ending July 7.

Arrangements will be made for a special train from New York to Milwaukee, to leave New York, on Tuesday, June 26. The route and time schedule will soon be announced. Members who can conveniently join the train at any point will be provided for.

The Trunk Line Association, The Central Traffic Association, The Western States Passenger Association, and the Southern Passenger Association, have arranged a rate for the round trip of one and one third the single fare.

The following new papers will be presented at the Convention:

"Improvement of Rivers on the Atlantic Coast", WILLIAM P. CRAIGHILL.

"High Walls or Dams to resist the pressure of Water", JAMES P. FRANCIS.

"Maintenance of Railway Structures", HENRY D. BLUNDEN; also a general discussion on this subject.

"Formulas for the Weights of Bridge Trusses", A. J. DU BOIS.

"An Investigation to determine the Strains in a Hollow Cast-Iron Disk, cooled from the Interior", G. LEVERICH.

"English Railroad Track", E. E. RUSSELL TRATMAN.

"An Automatic Waste Weir", A. D. FOOTE.

"Some Facts in relation to Friction, Waste and Loss of Water from Mains", CHALES B. BRUSH.

It is not intended to restrict in any sense the presentation of papers to the subjects above suggested.

It is expected that papers on several other interesting subjects will be presented.

Reports will be expected from the Committees on Uniform Standard Time; To Consider the proper Relations to Each Other of the Sections of Railway Wheels and Rails; On the Compressive Strength of Cements and the Compression of Mortars and Settlement of Masonry; On Grades and Titles of Engineers on Public Works, and those subjects will be discussed.

Circulars announcing certain details will be issued Saturday or early next week.

Engineers' Club of Philadelphia, Pa.—The regular meeting was held May 19; Vice-President, JOHN T. BOYD, in the chair; 42 members and 2 visitors present. Mr. WM. F. SELLERS, presented an illustrated paper on the Galloway Boiler. Mr. HENRY G. MORRIS opened the discussion of "How Should the Connections be Made between the Parts of Water-Tube Boilers"? which was participated in by Mr. JOHN OVERN, Chief of the Bureau of Boiler Inspectors, Philadelphia (visitor), and Messrs. M. R. MUCKLE, Jr., JOHN L. GILL, Jr., J. E. CODMAN, WASHINGTON JONES, and others, of the Club. The discussion took a wide range, covering much detail—the importance, for safety, of avoiding erroneous innovation in design and construction being specially emphasized. Mr. HENRY G. MORRIS exhibited, in operation, and described the Grove Electric Meter.

HOWARD MURPHY.
Secretary and Treasurer.

Liverpool Engineering Society.—The last meeting of the present session of this society was held May 9, 1888, at the Royal Institution, Colquitt Street; Mr. C. H. DARBISHIRE, President, in the chair.—A communication was read by the Secretary from Mr. E. GOBERT on the paper read at the previous meeting by Mr. BAMFORD, on air brakes. Mr. GOBERT said the question now was which kind of brakes, vacuum or compressed air, was most advantageous. When they considered the question, both from a practical and theoretical point of view, its solution must decidedly be in favor of the air pressure brakes, the most perfect and efficient of this class being the Westinghouse automatic brake, both in its usual form and the latest addition it has recently received from the inventor himself. The automatic brake, in its present form, might be a very serviceable brake on short trains, as used in this country, but it was entirely unsuitable for long trains, such as it is the practice to run on the Continent and in America. It was not known yet whether the automatic vacuum brake is affected by intense cold, as the old vacuum brake used to be, but intense cold had no effect on the Westinghouse brake, as the writer had occasion to witness some two years ago, while he was in Transylvania where the winter is generally more severe than it is in this country. It might, he said, be asserted with fairness that the Westinghouse brake had attained finality in the latest type produced by its inventor. An interesting discussion followed.—The following officers were then elected for the ensuing year:—President, Mr. C. H. DARBISHIRE; Vice-Presidents, Messrs. J. J. POTTS and H. H. WEST; Honorary Secretary, Mr. J. H. T. TURNER; Hon. Treasurer, Mr. O. S. PILKINGTON; Hon Librarian, Mr. J. A. BRODIE. During the recess it is proposed that the members shall visit the Forth Bridge, the Vyrnwy Water-works, the Preston Dock Works, and the Weaver Navigation Works.

Civil Engineers' Association of Kansas.—"Bridges" will be the subject of discussion at the next regular meeting of the Association. A paper will be prepared and read by a member who is a practical bridge builder.

This discussion was called out by a letter to the Association from B. W. DE COURCY, Chief Engineer of the Occidental Construction Co., asking that engineers use their influence in urging upon the State the need of a competent engineer to examine bridge structures and decide before the bridges are accepted whether they are safe or not. Thus, it is assured, much loss of life and loss to tax-payers would be saved.

The Association, at its last regular meeting, made important additions to the library.

The journals sent are duly appreciated. All papers should be addressed to the Civil Engineers' Association, 144 N. Main, St. Wichita, Kansas.

W. A. CRUSINBERRY, *Asst. Secretary.*

Engineers' Society of Western Pennsylvania:—The statement in our Pittsburgh correspondence, published May 19, that this society had adjourned for the summer, was due to a misunderstanding. A meeting was held on May 15, at which Mr. KOCH made an address on "Fifteen Years of Open Hearth Experience", of which we shall publish an abstract. The June meeting will be the last.

Michigan Sanitary Convention.—A sanitary convention will be held at Manistee, Mich., June 5, and 6, under the supervision of the State Board of Health. The following papers, with others, are to be read: "Water Supply of Manistee", Dr. J. A. KING; "Water Supply in General", V. C. VAUGHAN, of Ann Arbor; "Relations of the Press to Sanitation", A. M. SMITH, of Manistee. Dr. HENRY B. BAKER, Secretary, Lansing, Mich.

The Connecticut Civil Engineers' and Surveyors' Association.—The regular meeting will be held at Bridgeport, Conn., at the office of Hull & Palmer, rooms 18 and 19 Connecticut Bank Building, on Tuesday, June 5, 1888, at 10 o'clock A. M. The programme is as follows: Business meeting to be followed by a report of Committee on Wire Rope, introduced by paper from WM. B. PALMER, Bridgeport; discussion of the project of the formation of the Corps of United States Civil Engineers, introduced by paper from C. H. BUNCE, Hartford; 1 P. M., Lunch at Sand's restaurant, and at 2 P. M., complimentary excursion by steamer, to Long Beach.

Master Car-Builders' Convention.—It is announced that the Trunk Line and Central Traffic Associations state that it is impracticable to grant a reduction of fare from the Master Car-Builders' Convention, and there will, therefore, not be any reduction of the regular fare either to or from the Convention, as was announced.

M. N. FORNEY, *Secretary.*

Illinois Sanitary Conference.—A State sanitary conference was held at Springfield, Ill., May 17 and 18. There was a large attendance, and Dr. J. R. CORBUS, health officer of La Salle, was elected Chairman. The following papers were read and discussed on the first day: "Disposal of Garbage", by Dr. O. C. DEWOLF, health officer of Chicago; "Plumbing and Drainage of Houses", by W. H. GENUNG, inspector of plumbing, Chicago; "Disposition of Night Soil", by Dr. B. F. BUCKLEY, health officer of Freeport, Ill.; "Suppression and Prevention of Scarlet Fever", by Dr. L. H. COHEN, sanitary inspector of Quincy. The subject of "Preventable Diseases" was also discussed. On the second day Prof. JOHN H. LONG, of Chicago, gave an address on "Chemical Analysis of Water Supplies", and Dr. V. CURTIS, of Chicago, explained the method now being used in the biological examination of the water supplies of the State. The subject of "Vital Statistics" was discussed. Dr. JOHN H. RAUCH, Secretary of the State Board of Health, called attention to the work just begun by the Board in investigating the pollution of streams and water supplies; he also read a circular issued by the Board relative to the work now being carried on concerning the underground water supplies, and urged the members present to cooperate with the Board in this work.

The following resolution was adopted:

WHEREAS, Uniformity in the organization of the various boards of health of this State, together with having their powers and duties clearly defined by law, with the full and clearly defined means of enforcing the order of said boards, is a matter of such importance as to demand the attention of our law-makers; therefore be it

Resolved, That a committee of five be appointed to prepare a bill for an act to create boards of health in the several cities and villages of the State, defining their powers and duties and fixing their compensation, and cause the same to be presented to the next general assembly of this State, and urge its passage either as an amendment to the present act for the incorporation of cities and villages, or as an independent law.

The following were chosen as such committee: J. R. CORBUS, M. D., of La Salle, Chairman; PERRY A. ARMSTRONG, of Morris; B. F. BUCKLEY, M. D., of Freeport; C. ARMSTRONG, M. D., of Carrollton; E. ROWLAND, M.D., of Olney.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Cincinnati, Wabash & Michigan.—A force of graders has begun work at Knightstown, Ind., on the Anderson and Rushville extension.

Hereford.—The contract for building this line from Cookshire, P. Q., to the terminus of the Upper Coos Railroad at the New Hampshire boundary, has been awarded to Canadian contractors.

New York, Pennsylvania & Ohio.—Work will begin soon on the extension from New Lisbon to East Liverpool, O., 15 miles.

Hartford & Connecticut Western.—The Massachusetts Legislature has refused to pass the bill permitting this company to build an extension from Tariffville, Ct., to Springfield, Mass.

Cooperstown & Susquehanna.—Arrangements have been completed for building the 4½-mile extension to meet the extension of the Ulster & Delaware near Cooperstown, N. Y.

Lehigh Valley.—A line 17 miles in length is under construction from Fairview to Pittston, Pa., by Contractors Charles McFadden, Brodhead & Hickey, and Thos. H. Rickert. It is stated that the project for the construction of the Buffalo & Geneva line in New York has been abandoned for the present.

Dexter & Newport.—The towns of Dover and Foxcroft have subscribed about $60,000 toward the extension from Dexter to Dover of this Maine road. The Maine Central will lease the new line when completed at a rental of $12,500. The company will bond the line for about $70,000 and it is expected to pay stock dividends of about 5 per cent.

Bloomsburgh & Sullivan.—The citizens of Bloomsburgh, Pa., have made a liberal subscription to aid this company in building a bridge across the Susquehanna river at Bloomsburgh, connecting this line with the Pennsylvania system.

Canada & St. Louis.—This enterprise, whose headquarters are at Goshen, Ind., has been revived, and a contract has been let to J. J. Burns. A $25,000 subsidy is now pending at Goshen.

Boston, Concord & Montreal.—At the recent annual meeting the directors were authorized to take steps towards the construction of the Tilton & Belton, Tilton & Franklin, and Lake Shore Railroads.

Suncook Valley.—The extension of this New Hampshire line from Pittsfield to Barnstead is under consideration.

South Pennsylvania.—Surveys are reported in progress for lines west from Bedford, Pa. The Pennsylvania is also reported to have engineers in the field locating a line parallel to the Huntingdon & Broad Top Mountain Railroad, about 18 miles in length.

Pennsylvania.—The Cambria & Clearfield Railroad, from La Jose, on the Bell's Gap road, about 9 miles westward, is nearly completed.

Louisville, Evansville & St. Louis.—Construction is to begin at once on a branch line from Marengo to French Lick Springs, Ind., the terminus of a branch of the Louisville, New Albany & Chicago.

Cincinnati, Wheeling & New York.—It is rumored that an extension will be built this season from Morgan Junction, Pa., to Freeport, O., about 22 miles.

Chicago & Northwestern.—The tracklaying is nearly completed on the extension in the north Michigan peninsula from Ishpeming to Champion and Republic. Work will probably begin this fall on the extension to Houghton.

New Projects and Surveys.

Vincennes, Oakland City & Owensboro.—The city of Owensboro, Ky., has voted $45,000 in aid of this enterprise. Various Indiana townships have already voted $112,000 to the company.

Manchester & Portland.—The Manchester (Ct.) Business Men's Association has appointed a committee to confer with capitalists in regard to the construction of this proposed line for which surveys were made this spring.

Pittsburg, Akron & Western.—WM. SEMPLE of Pittsburg, Pa., has been elected President of this company and it is stated that there is now a fair prospect that grading may begin on the road at an early date. It is rumored that J. W. HOLLOWAY of Akron will be General Manager of the Western division.

Boston & Quebec Air Line.—A charter for this company has been asked of the Quebec legislature.

Canastota, Morrisville & Southern.—Chief Engineer WALTER F. RANDALL is making surveys between New Berlin and Earlville N. Y.

SOUTHERN

Existing Roads.

Georgia, Carolina & Northern.—Track has been laid to the Catawba river, 22½ miles from Monroe, N. C. The iron bridge over the Catawba is expected to be finished in about six weeks.

Louisville & Nashville.—About 18 miles are graded on the Huntsville extension, in Alabama, from Boyles, 6 miles north of Birmingham, to Village Springs, and track is to be laid at once. The Gate City extension has been completed to Gate city, 7 miles from Birmingham, and is to be extended to Trussville, 11 miles farther, at once.

Lookout Mountain.—The standard gauge line to the top of Lookout Mountain, near Chattanooga, Tenn., was opened for traffic May 26. The line is 10 miles in length.

Tennessee Coal, Iron & Railroad Co.—A dispatch from Abingdon, Va., May 28, states that two engineers in the employ of this company, were fired upon by a body of men concealed in the bushes, and killed. The trouble arose over a dispute regarding the ownership of lands claimed both by the settlers and the company.

Oxford & Durham.—Grading will be finished on this North Carolina line by June 15, and trains are expected to be running by August 1.

Talladega & Coosa Valley.—Plans are being discussed for an extension from Talladega, Ala., through Clay county to Ashland and Newnan, Ga.

Kentucky Union.—Clark county Ky., will vote June 9, on the proposition to subscribe $100,000 to the stock of this road on condition that it is completed from Winchester to a point 15 miles beyond Clay City, Powell county in one year and to Breathitt county in two years. The company has filed a mortgage to the Louisville Safety Vault & Trust Co., to secure $800,000 of 20 year bonds.

Versailles & Midway.—About 200 hands are at work on the extension from Midway to Georgetown, Ky., under contractors Mason & Hoge. Trains are to be running by Sept. 1.

Troy & Tiptonville.—Tracklaying is in progress on the 6 miles graded from Rives to Troy, Tenn., and trains are to be running by June 15.

Cape Fear & Yadkin Valley.—The northern extension has been completed to Mt. Airy, N. C. Grading on the Madison branch will be completed in about 6 weeks The locating surveys are in progress on the Wilmington extension.

Powell's Valley.—The name of this line under construction in eastern Tennessee is to be changed to the Knoxville, Cumberland Gap & Louisville.

Carolina, Knoxville & Western.—A mortgage on the entire line of this road from Knoxville, Tenn., to Augusta, Ga., 282 miles, has been executed to the American Loan & Trust Co., of New York, in trust for the Georgia Construction & Investment Co., which is building the road. The total amount of the mortgage is $11,280 000, being at the rate of $40,000 per mile.

Chesapeake, Ohio & Southwestern.—This company has filed a mortgage on the road between Memphis, Tenn., and Louisville, Ky., to the amount of $3,000,000. The money is to be used in building and equipping branch lines.——The Dayton Car Works have contracts for about 5 000 cars for the lines of the Huntington system.

Anniston & Atlantic.—This Alabama road has been consolidated with the Georgia Central system.

New Projects and Surveys.

Dayton & Farmsdale.—Incorporated in Alabama to build a road from Dayton to Farmsdale, on the East Tennessee, Virginia & Georgia, a distance of 8 miles. R. W. PRICE of Dayton is interested.

Uniontown, Newberne & Dayton.—Incorporated in Alabama to build a railroad from some point near Newberne to some point on the Tombigbee river near Beaver creek. J. C. WELCH of Uniontown is interested.

Lynchburg Belt.—This company has been organized at Lynchburg, Va. JOHN E. PETTYJOHN is President and JAS. CLARK is Secretary and Treasurer.

Missouri, Tennessee & Georgia.—A preliminary survey is in progress from Humboldt, Tenn., to a point opposite New Madrid, Mo.

Augusta & Florida.—A company has been formed to build an Air line railroad from Augusta *via* Mellen and Jesup to Jacksonville, Fla. W. E. H. SEARCY of Griffin, Ga., is President.

THE NORTHWEST.

Existing Roads.

Minneapolis & Pacific.—The preliminary survey which has been made from Monango, Dak., northwest 50 miles is not favorably considered; and the engineers are now at work on a line from Monango southwest to a connection with the Aberdeen, Bismarck & Northwestern, at Ashland, McIntosh county.

Milwaukee, Lake Shore & Western.—Surveys are again in progress on the proposed extension of this line from Wausau, Wis., to Marshfield, for which a preliminary line was surveyed last season.

Chicago & Northwestern.—Track has been laid this year on the Lake Geneva & State Line from Lake Geneva, Wis., to Williams Bay, a distance of 6 miles, and the line has been opened for traffic.

Chicago, Burlington & Northern.—Surveys are in progress and right of way and subsidies are being obtained for a line to Marshfield, Wis.

Sault Ste. Marie & Southwestern.—A force of engineers is engaged on the survey of this projected line west of the Mississippi river, from the site of the proposed bridge at Alma, Wis.

St. Louis, Alton & Springfield.—The location of the Springfield extension is to be made at once, and grading will then begin under Johnson Bros. & Faught, of Alton, the contractors who are building the Alton extension. It is intended to have the latter line open for traffic by July 1.

Missouri Pacific.—President GOULD is making a tour over the system, and it is rumored that he will look into the matter of the proposed extensions from Omaha, Neb., to Yankton, Dak., and from Hastings Neb., northwest.

Red River Valley.—A Winnipeg dispatch of May 25, states that the Provincial Government has called for tenders for the construction of a railway from Winnipeg to Portage La Prairie, 65 miles.

Northern Pacific.—Surveys are reported in progress for a line in northern Dakota, west of the Red River valley. The line runs from St. John's, in the direction, of Boissevain, Man.

Port Arthur, Duluth & Western.—The Government subsidy of $271,000 just granted to this company, and the fact that President THOS. MARKS has succeeded in floating the bonds of the company in England, ensure the construction of the line. Grading was completed last season from Port Arthur, west, 11 miles. HENRY K. WICKSTEED, of Port Arthur, is Chief Engineer.

New Projects and Surveys.

Bismarck, De Smet & Sioux Falls.—This company has been organized at De Smet, Dak., to build a railroad from Sioux Falls to Bismarck, in an air line. A glance at the existing lines in Dakota must convince anyone that the need of such a line, and the possibility of its construction, are exceedingly small.

THE SOUTHWEST.

Existing Roads.

Chicago, Rock Island & Pacific.—The company has been running trains over the Union Pacific line from Topeka to Kansas City for several months, but by a recent ordinance it has been granted right of way for extensive terminals at Kansas City and will at once begin their construction.

St. Louis & San Francisco.—The contract for building the extension from Bluff City to Anthony, Kan., has been let to Luman, York & Hatton, of Wichita, Kan., the work to be completed by July 1. The line is about 10 miles in length. The probabilities of a Kansas City extension continue to be discussed, and it is rumored that negotiations are in progress for the purchase of the Kansas City and Pacific line from Parsons, Kan., northeast. Two preliminary surveys are reported in progress from Monett, Mo., toward Kansas City. One running *via* Mt. Vernon and Stockton, and the other through Barton county.

Louisiana North & South.—This company, the Natchitoches, and the Kansas City, Watkins & Gulf project have been consolidated under the title of the first.

Kansas City, Wyandotte & Northwestern.—The Kansas City *Times* publishes an interview with Vice President and General Manager, NEWMAN ERB, in which he is reported as saying that the engineers at work on extensions had been discharged because, "They had completed their work, and as we do not want to begin building right away of course we had no use for them. The country through which our line runs is essentially a corn country, and we do not want to build until we are certain that there is going to be a big crop".

It is a new idea in railway economics that the construction of a railroad line should be dependent on the crop returns of a single season.

St. Joseph Lead Co.—John Ball has taken a contract for grading on this Missouri line which is to run from Doe Run Mines, St. Francois county to Pevely or Crystal City, on the Mississippi.

Chicago, Burlington & Quincy.—Tracklaying is in progress on the extension from Blakeman to Wano, Kan., graded last season.

New Projects and Surveys.

Chicago, Hannibal & Springfield.—A press dispatch from Hannibal, Mo., states that W. E. WILLIAMS, Chief Engineer of this projected Missouri line, is making a reconnoissance for a line from a point opposite Hannibal to Havana, Ill. This causes much discussion as to the probable interest which is back of the scheme, some holding that the Rock Island is furthering the project, while others consider that the Illinois Central intends to reach out to the Southwest. The more likely supposition, however, is that the project is at present an independent enterprise, though it is not improbable that its promoters intend to sell out at the right time to some of the large systems.

New Orleans, Natchez & Fort Scott.—President JOHN H. RICE of Fort Scott, Kan., is still actively at work obtaining subsidies and rights of way for his proposed line. The Louisiana parishes through which it is to run have generally made liberal subscriptions, and an attempt is being made to interest New Orleans capital in the construction. There seems, however, little prospect that this can be done, as New Orleans is not at all disposed to exert itself in the direction of additional commercial facilities. It seems pretty certain that the Southwest is destined soon to a great industrial development accompanied by a large amount of railway building; but capital is still averse to investments in this section and the many projects move but slowly toward realization.

Kansas City & Bonner Springs Rapid Transit.—A preliminary survey has been made for this suburban line at Kansas City, 15 miles in length. W. A. SIMPSON is President.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Colorado Midland.—At the recent annual meeting at Colorado Springs, it was voted to lay track at once on the extension which has been graded from Glenwood Springs to Newcastle, Col., about 10 miles. President HAGERMAN'S resignation on account of ill health was reluctantly accepted.

San Joaquin Valley.—All work has ceased on this road, which parallels the Southern Pacific extension from Tracy, Cal., south. The directors state that the enterprise is not to be given up but that work will soon be resumed. The Southern Pacific line is completed to a point opposite Madera, on the main line, and graders are now working south of Fresno.

Portland & Vancouver.—The locating survey is in progress for this suburban railway line at Portland Ore., under R. A. HABERSHAM, Chief Engineer. Rails and equipment have been purchased and work will begin at once on the construction.

Fresno, Belmont & Yosemite.—The work on this California line has made rapid progress, and cars are running on a short section of the line. E. C. WINCHELL, of Fresno City, is President, and I. TIELMAN is Chief Engineer.

Seattle, Lake Shore & Eastern.—This is now the longest line and most important under contract in the Pacific States. About 300 miles are now under contract on this line, as previously announced, and the Seattle & West Coast road, 90 miles in length, is under construction. PAUL F. MOHR, of Seattle, is Chief Engineer.

Northern Pacific.—The first train was run through the Cascade tunnel on May 27.

Guatemala Central.—There is a good prospect that this railway, the principal line of the State of Guatemala in Central America, will be extended 320 miles to a terminus on the Atlantic coast. The Government has granted liberal concessions for the work to JOHN P. ANDERSON of Livingston, the proposed terminal point on the Atlantic coast. The principal owners of the line are Messrs. HUNTINGTON, CROCKER and HOPKINS of the Southern Pacific. A. J. FINLAY of Guatemala city is General Manager. The offices of the company are in San Francisco.

Oregon Ry. & Navigation Co.—Two preliminary surveys have been made for the extension from Endicott to the Cœur d'Alene reservation, one *via* Farmington and the other *via* Oakesdale.

Northern California.—Surveys have begun for the extension from Marysville to Knights Landing, Cal. under direction of T. W. BEECK.

New Projects and Surveys.

Mazatlan, Culiacan & Coast.—This Mexican enterprise is now to be known as the Mexican Pacific. The proposed line is to run from Hermosillo, on the Sonora Railroad, to Mazatlan, about 800 miles; and it is proposed eventually to continue it south to the city of Mexico and north to a junction with the American railway systems near Tucson, Ariz. This is the line in which San Francisco capitalists are interested. EDMOND GREEN is President and WM. H. MCWOOD is the Mexican representative.

Yreka Branch.—The project for the construction of a branch line from the main line of the Oregon & California at or near Montague to Yreka, a distance of 10 miles is again being agitated. The line was located a year ago but no work has been done. A company has now been organized at Yreka to build the road. J. M. WALBRIDGE, J. CHURCHILL and H. B. GILLIS are interested.

Wyoming Midland.—This company has been organized in Wyoming to build a railroad from a connection with the Northern Pacific, south through the Big Horn Valley to Lander, Tremont Co., about 200 miles. NELSON W. BREWSTER, THOS. FRANKLIN, JACOB HITCHCOCK, DOUGLAS SMITH and CHAS. F. ROBERTS of New York City are interested. The same parties are interested in the Billings, Clark's Fork & Cooke City enterprise.

Billings, Clark's Fork & Cooke City.—The United States Senate has passed the bill granting this company right of way through the Crow Indian reservation in Montana.

Coquille River & Coos Bay.—This company has been organized in Oregon by S. F. WILSON, C. F. LOVELACE and others to build railroads and telegraph lines from Coos bay to the Coquille river. W. R. WHIPPLE is Chief Engineer. Some preliminary surveys have been made.

San Francisco & Santa Cruz.—Surveys are in progress on this California road under Chief Engineer F. S. NEWBERRY. The line has been run from Colma to Point San Pedro, San Mateo county.

Kansas City, El Paso & Mexican.—Under the sensational heading: "To be settled by shedding blood", the St. Louis *Globe Democrat* says:

"A repetition of the canyon war of Colorado during the summer of 1879 may be expected shortly in Lincoln county, N. M. The Kansas City, El Paso and Mexican Railroad Company, recently formed, and consisting principal y of St. Louis capitalists, has just finished a preliminary survey, and is on the point of commencing active work. The line to be built goes from El Paso to White Oaks, and its northern division runs in several places through narrow canyons which present the only practical means of crossing certain mountain ranges. The possession of these canyons is indispensable to any railroad that wants to reach the White Oaks country. Now the Atchison, Topeka & Santa Fé is greatly interested in either preventing the line to be built or in reaching the White Oak country with a branch line of its own first. Both companies are fully alive to the importance of securing these canyons, and an interesting struggle is anticipated."

The above is based on the assumption that the Santa Fé managers are especially anxious to build a line across the deserts of New Mexico to El Paso, a matter which is open to serious doubt.

Tacoma, Ellensburgh & Conconnully Ry. & Navigation Co.—

TACOMA, W. T. May 22, 1888.

EDITOR ENGINEERING NEWS:

Our railroad and navigation line is to run from Ellensburgh, Kittitass Co., W. T., a station 133 miles east of Tacoma on the Northern Pacific Railroad, to the Columbia river, a distance of 33 to 35 miles by rail. The landing at the river will be at Port Eaton. From Port Eaton we shall run as many boats as may be necessary for the traffic north to the Conconnully mining district in Okanagon Co. We shall have about four intermediate landings, tapping the Wenatchie, Big Bend and Okanagon valleys, which are rapidly filling up. The grading of our railroad line will cost in the neighborhood of $5,000 per mile. We have an easy grade from Ellensburgh to the summit, 18 miles, 1 per cent. From the summit to the river we have a 2.75 per cent. grade. Our engineering corps is now in the field, the preliminary survey is made, and they are at work on the location. THOMAS L. NIXON is Chief Engineer. The company is capitalized at $1,500,000. The Columbia Improvement Company will furnish capital for the construction. The line is an independent one, based on actual necessity, and will be an important feeder to the Northern Pacific Railroad. How much they will become interested in the matter, time only will determine. The company is now securing the right of way as fast as the location is made. This transportation line is to open up a rich agricultural and mining region, one of the richest in the Northwest and has more to sustain it than any new enterprise projected in this section. It will a paying investment from the start. L. E. POST, *President.*

Contracting.

Depot.—The contract for the Columbus & Western freight depot at Birmingham, Ala., has been awarded to James M. Farland.

Stand Pipe & Crib.—The contract for the stand-pipe for the water-works at Camden, N. J., has been awarded to A. D. Wood & Co., of Philadelphia, for $5,780, and for the crib to Henhoefler & Vaughan.

Lamp Posts.—The Commissioner of City Works, Brooklyn, N. Y., has received proposals from the Metropolitan Gas Light Co., the Williamsburg Gas Light Co., and the Nassau Gas Light Co., for setting gas lamp posts, at $25 each.

The Bodwell Granite Co., of Rockland, Me., has the contract for the granite for the Methodist Bible House to be built on the corner of Fifth Av. and 20th St., New York City. The granite is to be Jonesboro red, first two stories rock face and the remainder hammered.

The Maine & New Hampshire Granite Co., North Conway, N. H., has a large contract for paving blocks for New York City.

Cement.—The following proposals for 1,000 bbls. of Portland cement have been received by the Docks Commissioners, New York City: Howard Fleming, $2.24 per bbl.; Marcial & Co., $2.38; Erskine W. Fisher, $2.29; E. Thiele, $2.29; S. L. Merchant & Co., $2.33; Habler & Co., $2.35; Empire Warehouse Co., $2.35; A. C. Babson, $2.40; Johnson & Wilson, $2.40.

Electric Railway.—An electric street railway is projected at Fresno, Cal. The Julien storage battery system will be used. About $30,000 has been subscribed

Water-Works.—The following proposals were received by the Louisville Water Co., Louisville, Ky., May 15: Inlet and river work: Donald McDonald, Louisville, Ky., $16,890; Sooysmith & Co., New York, $17,400; Shanahan & O'Connor, Louisville, $18,000. Engine house and engine foundations: Donald McDonald, $218,114.55; Sooysmith & Co., $221,440.50.; Shanahan & O'Connor, $236,582.50.

Dam.—In our advertising columns is an advertisement for proposals for lining or making water-tight a storage reservoir, already built, at Franklin, Pa., with a capacity of 17,000,000 galls. Bidders to submit plans and specifications. "The dam is across a ravine, and while the dam itself is all that could be desired, the water leaks through the broken rocky strata forming the hillside and passes out in large volume at some distance from the dam." Proposals will be received until June 20. F. W. MITCHELL, President, Venango Water Co., Franklin, Pa.

The Laidlaw & Dunn Co., of Cincinnati, O., has been awarded the contract for two of its "duplex" steam pumps to pump water for the grand water-falls and fountains in Horticultural Hall and also for the large elevator pump for Washington Park Department, at the Cincinnati Centennial Exposition, opening July 4 and closing Oct. 27th.

To Manufacturers.—The Board of Trade, of Council Bluffs, Ia., will present 1,000 acres of land free to manufacturing enterprises. Taxes rebated for 10 years. The city has a population of 35,000. Address the Secretary of the Board of Trade.

Street Railway Track.—The following proposals for laying the flooring plank on roadway and sidewalks, paving the roadway with pine blocks and laying the rails for a double track street railway upon the iron portion of the Central Viaduct between Jennings Ave. and Hill St., have been received by the Board of Improvements, Cleveland, O.: Ripley & Kuentz, 2,900 lin. ft. of double track in position, 20 cts. per ft.; 2,900 lin. ft of double track having both sides of each rail filled with cement, 20 cts. per ft.; 1,200 lbs. of spikes, 3 cts. per lb; 12,100 sq. yds. of wood pavement furnished and laid, $1.14 per sq. yd.; total, $14,954.36. B. McCarthy, 19½ cts. 7 cts., 84 per 100 lbs., $1.23½, $15,760. Albert Hartzell, 12 cts., 34 cts., 84 per 100 lbs., $1.27, $16,749. Claflin Paving Co., 7¼ cts., 7 cts., 4½ cts. per lb., $1.37, $16,998. A. M. Emerson, 8 cts., 15 cts., 84 per 100 lbs., $1.37, $17,282. The contract was awarded to Rieley & Kuentz. SAM BRIGGS, Clerk of the Board of Improvements. W. P. RICE, City Engineer.

The Ingersoll Rock Drill Co.—The business of the Ingersoll Rock Drill Co. has been brisk and increasing since the beginning of Spring. They have recently made several foreign shipments of air compressors drills, etc., comprising a plant to China, one to Liverpool, two to Mexico, and one to South America; and have now under way, a complete plant for the Pacific, coast of Mexico to be transported on muleback, the compressors, receiver, and all heavy machinery being cut up into sections. For railroad work they have recently taken orders from the Norfolk & Western, New York Central, and Philadelphia & Reading, and they have shipped an air compressor plant to contractors on the Cumberland Gap tunnel in Southern Tennessee. In mining they have orders for air compressors, drills, etc., from Cooper, Hewitt & Co., the King Iron Ore Co., the Bessemer Iron Co., and the New Jersey Iron Mining Co., and have just shipped 6 "Sergeant" drills, (making 12 in all recently sold) to the Minnesota Iron Mines in Minnesota. They have recently shipped stone channeling machines to the Warsaw Bluestone Co., Warsaw, N. Y.: Brainerd Quarry Co., Connecticut, and to Robinson & Cary, St. Paul, Minn. Orders are on hand for channelers, cadders, portable boiler, etc., for the Orvillo and the Esperanza marble companies of West Rutland, Vt.

The Toledo Foundry & Machine Co., of Toledo, O., has issued a neat 57 page illustrated catalogue. The company manufactures excavators, graders, ditchers, pile drivers (with or without Cram's patent steam hammers), ballast unloaders, snow cleaners and flangers, locomotive turntables, railroad velocipedes, dredges, tugs, tools and general machinery. There is a full illustrated description of Stock's patent Victor excavators, used for various purposes. There are a number of full page engravings. A pneumatic snow plow is described and illustrated; also Cram's pile hammer. The company has a new and improved independent swinging arrangement for excavators and dredges. Three pages are devoted to testimonials of excavators. The following is a comparative table of work accomplished by 3 standard excavators:

Excavator	Best Days Work.	Cost.	Yds. per Hour.	Cost per Yd.	Hours Worked.
	Cu. yds.	$	Yds.	Cts.	
——	1,600	22.00	133	1⅜	12
——	2,000	29.00	166	1⅝	12
Stock's,	2,640	19.80	220	0¾	12

Sea-Wall.—At a recent meeting of the State Board of Harbor Commissioners at San Francisco, Cal., Chief Engineer MARSDEN MANSON submitted estimates made by a contractor for the construction of Section 8 of the sea-wall. Mr. MARSDEN recommended a section 900 ft. long. The estimates are as follows, the first being for the same plan of construction as that of the sections already built and the second being for a concrete wall on pile foundation.

Driving 1,700 old piles	$ 8,500
Repairs to dredging plant	5,000
104,000 tons stone	104,000
92,000 cu. yds. earth	36,800
54,000 sq. ft. wharf	21,600
	$175,900
Contingencies, 20 per cent	35,180
Estimated total	$211,080
Cost per foot, $234.53	

Repairs to dredging plant	$ 8,000 00
Driving 1,700 old piles	8,500 00
Coffer-dam	6,340 00
Pumping plant and operating	16,870 00
Pile foundation	32,312 00
Concrete wall	108,675 00
Earth filling, 164 000 cu. yds	65,000 00
Total	$245,697 00
Contingencies, 20 per cent	49,139 00
Total estimate	$294,836 40
Cost per lineal foot, $327 60	

Sewer Pipe Works Wanted.—G. WAHLER, of 710 S 2nd St., Leavenworth, Kan., advertises for parties to develop a business for the manufacture of terra cotta, tile, sewer pipe and cement. He has clay fields near the city, with tile and pressed brick machinery in operation.

Sewer Bonds.—At Colorado Springs, Col., the Council opened 4 bids May 21 for the purchase of $50,000 of sewer bonds. The highest bid was from the Fidelity Trust Co., of Kansas City, Mo., $1.01½. The council thought the bonds should bring a higher premium, so all the bids were rejected and new bids advertised for, which will be opened June 4.

Steel Rails.—The Colorado Coal & Iron Co., at Pueblo, Col., has the contract for the rails of the Seattle, Lake Shore & Eastern Ry., between Seattle and Spokane Falls, Wash. Ty. The company's steel works plant will be in operation by June.

Texas Asphalt Beds.—Palestine, Tex., May 25. Jas. Logan, received a telegram this morning from R. J. Byrnes, a contractor of Galveston, that he had ordered machinery from Chicago and as soon as it arrived, would be here with a force to work the asphalt beds lately discovered on the Logan lands, 10 miles east of Palestine. Some months ago a company was formed and at considerable expense made numerous excavations on the Logan and adjoining lands in the search for petroleum which was not found in satisfactory quantities, the necessary means not being convenient to make adequate tests. In all the wells dug, however, veins ranging from 20 to 30 feet were struck containing a solid substance of what was supposed to be asphalt After a thorough practical test and scientific analysis of the substance, contractor Byrnes pronounces it an excellent quality of asphalt. St. Louis, Mo., *Globe Democrat.*

New Croton Aqueduct.—The following proposals for deepening and finishing Shaft No. 24 have been received by the Aqueduct Commissioners New York City:

Items.	Quantities.	Chas. Peterson, New York.		O'Brien & Clark, New York.		Engineer's Estimate.	
		Price.	Amount.	Price.	Amount.	Price.	Amount.
Earth excavation	2,500 cu. yds.	$ .30	$ 750	$ .60	$ 1,500	$ .40	$ 1,000 00
Rock "	250 "	1.50	375	3.00	750	3.00	750.00
Tunnel "	125 "	8.00	1,000	9.00	1,125	10.00	1,250 00
Shaft "	170 lin. ft.	325.00	55,250	250.00	42,500	200.00	34,000,00
Emptying Shaft No. 24 and adjacent incline	3,000 00	3,000	7,000.00	7,000	4,000.00	4,000.00	
Pumping or draining	150,000,000 galls.	45.00	6,750	60.00	9,000	50.00	7,500,00
Brick masonry	1,200 cu. yds.	13.00	15,600	11.00	13,2 0	10.00	12,000.00
Concrete " , 5 : 1	25 "	6.00	150	6.00	150	5.00	125.00
Concrete " , 3 : 1	25 "	7.00	175	6.00	150	6.00	150.00
Rubble "	3,000 "	4.00	12,000	5.00	15,000	5.00	15,000,00
Rubble " face work	250 sq. ft.	.30	75	.80	200	.25	62.50
Cut stone "	80 cu. yds.	25.00	2,000	60.00	4,800	45.00	3,600.00
Face dressing, rough pointed	500 sq. ft.	.50	250	1.00	500	.50	250,00
Face dressing, 6-cut	1,200 "	.60	720	1.00	1,200	.80	960.00
Masonry in Port. cement mortar, extra	500 cu. yds.	2.50	1,750	2.00	1,000	2.00	1,000.00
Masonry in Am. cement mortar, "	500 "	2.00	1,000	1.00	500	1.00	500.00
Total			$100,345		$98 575		$82,147 50

Samuel R. Bullock is now the name of the former firm of Samuel R. Bullock & Co. Mr. Bullock will carry on the business of engineer and contractor at 11 Wall St., New York City.

Dredging.—The following proposals for dredging in the Thames river, Connecticut, have been received by Lt. Col. D. C. HOUSTON, U. S. Engineer Office, New York City: Hartford Dredging Co., Hartford, Conn., 19 cts. per cu. yd.; W. H. Beard, Brooklyn, N. Y., 20 cts.; Morris F. Brainard, New York, 24 cts.

Boilers.—The contract for 4 boilers for the Asylum for the Insane, at Athens, O., has been awarded by A.B. RICHARDSON, Superintendent, to J. T. Dougherty, at $2,365 for Otis steel boilers without fittings.

Water Tower.—The following proposals for the construction of a water tower at Mt. Belle ua were opened May 26 by the Water Board, Boston, Mass.: Lewis C. Knight, $5,760; W. H. Keys & Co., $5,999.50; R. R. Mayers & Co., $6,995.

Pier Work.—The Docks Commissioners, New York City, have received the following proposals for repairing the pier and crib bulkheads at W. 11th St., North River: John Gillies; bulkhead, $9,184; pier, $8,216; total, $17,400; John W. Flaherty, $10,244, $9,457, $19,701. The contract was awarded to John Gillies.

Car Works.—The U. S. Rolling Stock Co., which has bought out the Anniston Car Wheel, Axle & Car Works, at Anniston, Ala., has let contracts for the construction of a car repairing shop, 500 x 96 ft.; car paint shop, 325 x 96 ft.; machine and blacksmith shop, 825 x 105 ft.; and wood-working shop, 1,000 x 105 ft. The first foundry, 130 x 84 ft., is nearly completed, and another is to be built, 160 x 84 ft. About $100,000 worth of machinery has been ordered.

The Northwestern Sewer Pipe Co. is the new name of the reorganized Fox River Sewer Pipe Co. The new organization includes a firm at St. Paul, Minn. The business at St. Paul will be continued in connection with that at Oshkosh, Eau Claire and Neenah, Wis. The company has factories in all of these places and Oshkosh will be the headquarters. President, OSSIAN COOK; Secretary, A. W. JONES. Capital stock increased from $30,000 to $100,000.

Pumping Engines.—The following proposals for a pumping engine of 1,500,000 galls. daily capacity, with water pressure of 65 lbs. and steam pressure of 75 lbs. have been submitted to the Water Committee, of Portland, Ore., by Superintendent I. W. SMITH, the cost being for pumps delivered in Portland.

Non-compound non-condensing high-pressure pump	
One duplex Dean pump	$1,050
Two duplex Dean pumps	1,450
One single Hooker pump	2,000
Two single Hooker pumps	2,100
One duplex Holly pump	2,800
Compound non-condensing pump.	
One single Dow pump	3,450
One duplex Dow pump	4,000
One duplex Holly No. 4	3,500
One duplex Holly No. 5	4,800
Compound condensing pump.	
One single Davidson pump	5,600
One single Dow pump	4,140
One duplex Dow pump	4,669
One duplex Worthington pump	4,150
One duplex Holly No. 4	3,800
One duplex Holly No. 5	4,850

For crank and fly wheel, automatic cut off Holly pump non-compound non-condensing, $4,800. Non-compound duplex-condensing jet condenser, $5,300. Non-compound duplex-condensing surface condenser, $5,600. Compound duplex-condensing, $7,400. Compound duplex for 2,000,000 galls., $9,000.

The duty of the engines is as follows: Non-condensing pumps, 10,000,000 to 15,000,000; compound condensing, 30,000,000 to 50,000,000; crank and flywheel non-condensing, 60,000,000; crank and flywheel condensing, 75,000,000.

Precipitation Tanks, Etc.—The Water Board of Boston, Mass., have received the following proposals for building 4 precipitation tanks, with appurtenances, an engine house, auxiliary building, sludge well and branch sewer at Winchester, Mass.; the work including 850 cu. yds. excavation, 75 cu. yds. brick masonry and 13 cu. yds. concrete; Joseph Ross, Boston, $7,095.50; John McLaren, Boston, $7,900; S. Sanborn, Boston, $9,165; W. H. Keyes & Co., Boston, $9,508.75. The contract was awarded to Joseph Ross.

Railway Ballasting.—The following proposals for ballasting the Natchitoches R. R. between Prudhomme and Natchitoches, La., have been received by L. CASPARI, President, New Orleans; John Moylan, New Orleans, 45 cts. per cu. yd.; H. F. S. Martin, Vicksburg, Miss., 36 cts.; Green & Brogan, New Orleans, 35 cts.; A. G. Garrett, New Orleans, 35 cts.; O. S. Burdett, New Orleans, 33⅓ cts. P. Noonan, New Orleans, 33 cts.; J. B. Buckner, New Orleans, 25 cts., and for raising, lining, surfacing, etc., $800 per mile; Jas. Parker, Natchitoches, 32 cts.; all pit measurement. The contract was awarded to Jas. Parker. Work has been commenced and the road is to be put in first class condition.

Sewers.—The City Council of Fort Scott, Kan., has let a contract for sewers to John McDonald, at the following prices: 8, and 10 and 18-in. sewer, $1.40, $1.50, 1.65 per ft.; 6 and 8-in. laterals, $1.45 and $1.50 per ft.; masonry in manholes, $3.50 per cu. yd.; iron castings, 5 cts. per lb.; masonry at outlet, $2 per cu. yd.; total, 10,871. The other bids were, Geo. Patterson, $13,330; Jenkins & Dean, $14,325; E. J. Peck, $15,072.

Proposals Open.

Road.—About 2 miles of macadam road in the villages of Wakefield and Kingston. Specifications on application. BERNON E. HELM, Kingston, R. I.

Building.—Masonic temple; bids for work complete, or for masonry, wood work, iron and roof separately. G. P. MCMAHON, Ludington, Mich. June 4.

Bonds.—Sewer bonds for $50,000. THE CITY CLERK, Colorado Springs, Col. June 4.

Water-Works.—At Clarksburg, W. Va. Laying 617 tons of 4 to 10-in. cast-iron pipe; setting 24,000 lbs. of castings, 35 stop valves, 51 hydrants and 33 stop boxes; making a pipe system of about 6 miles. Brick pumping station with slate roof and brick chimney. Masonry influent well. JOHN W. HILL, Consulting Engineer, Cincinnati, O. THE COMMISSIONERS OF WATER-WORKS, Clarksburg, W. Va. June. 5.

Street Work.—Grading, curbing and cindering. GEO. H. SIMPSON, City Engineer, Terre Haute, Ind. June 5.

Hydrants, Stop Cocks, Etc.—Furnishing and delivering hydrants, stop-cocks, wooden hydrant boxes and cast-iron stop-cock boxes. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. June 8.

Street Work.—Regulating, curbing, granite and trap block paving. THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. June 8.

Pile Bridge.—THE ROAD COMMISSIONERS, Concord, Mass. June 8.

Heating and Ventilating.—Steam heating and ventilating for the State Normal School at Moorhead, Minn. J. W. STEVENS, of St. Paul, Architect. Hon. D. L. KIEHLE, St. Paul, Minn. June 9.

Water-Works Bonds.—Bonds for $40,000 for waterworks; to be sold at par, lowest rate of interest accepted. P. W MURRAY, City Treasurer, St. Ignace, Mich. June 11.

Pipe Laying.—Trenching, hauling and laying 240 lin. ft. of 48-in. pipe, 4,800 ft. of 36-in., 100 ft. of 12-in., 50 ft. of 8-in., 100 ft. of 6-in.; setting 5 fire plugs; furnishing 1,500 lbs. of wrought-iron straps, bands and bolts. HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo. June 11.

Water-Works.—Furnishing material and constructing works complete. Receiving basin, 20 × 30 ft.; reservoir, 200 ft. square; 1,828 ft. of 6-in. cast-iron pipe, 35,870 ft. of 10-in., and 7,000 ft. of 12-in. Also the trenching and back filling, all necessary specials, gates, valves, etc., required to complete the work according to the plans and specifications of D. M. GREENE, Engineer, which can now be examined at the office of C. W. BREED, Malone, N. Y. The work is to be completed by Oct. 25, 1888. THE EXTENSION COMMITTEE, Malone Water-Works Co., Malone, N. Y.

Pumping Engine.—One pumping engine with a daily capacity of 7,500,000 galls., against a resistance of 90 lbs. for current service and to work against a fire pressure of 150 lbs. Also bids for the purchase of one compound, non condensing, direct acting pumping engine, now at the pump station. J. D. COOK, Consulting Engineer, Toledo, O. THE TRUSTEES OF THE WATER-WORKS, Springfield, O. June 13.

Lock House.—Completing the lock house at Lock No. 2, Kanawha River Improvement. Information can be obtained of A. M. SCOTT, Resident Engineer. Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, Kanawha Co., W. Va. June 21.

Water Works.—Collecting gallery, basin and pump-well, pumping house and engineer's residence: 2 compound condensing pumping engines of 2,000,000 galls. daily capacity, and 3 boilers; 8,700 ft. of 16-in. cast-iron pipe, 4,200 ft. of 12-in., 5,300 ft. of 10-in., 2,000 ft. of 8-in., 22,000 ft. of 6-in., specials; 62 double nozzle hydrants with 4-in. connections; 45 valves. Also for the construction of these works, the purchase of the present plant at a stated figure, and the maintenance of the whole for a period of 10 years on a basis of rates named by the city. The city to have the right to purchase the whole works at actual cost at any time after 10 years. Bids to state the percentage on the actual cost to be paid annually by the city for water for fire purposes. JOS. N. SHENSTONE, Chairman of the Fire, Water & Gas Committee, Brantford, Ont., Canada. June 26.

Water Pipe.—For Brooklyn, O. Furnishing and delivering, trenching, laying and backfilling about 6,500 ft. of 4-in. cast-iron pipe, with specials; also for 4 and 6-in. pipe and castings required during 1888; also for furnishing and laying a 4-in. main. H. M. FARNSWORTH, Village Clerk of Brooklyn, Cleveland, O. June 26.

Electric Lighting.—Lighting the city for 3 or 5 years with electricity or a combination of gas and oil. J. WARREN TIBBETTS, Chairman, Committee on Police and Lamps, Ithaca, N. Y. June 27.

WATER.

The Parana Water Works Co. has been incorporated in London, with a capital of $500,000, to furnish water supply to the town of Parana, in the province o Entre Rios, Argentine Republic.

Water Power.—The new water power improvements at Little Falls, Minn., were formally opened May 1 with considerable ceremony. The works are owned by the Little Falls Water Power Co.

Atlantic City, N. J.—The City Council has awarded contract for lighting Atlantic Ave. for 1 year from June The lights will cover 24 squares, and will be placed at intersection of each cross street.

The Southern Artesian Well Co. has been organ at New Orleans, La., with a capital stock of $10,000. President, LOUIS SCHWARTZ; General Manager, ISAAC FEITEL. The company has a contract to sink a 700 ft. well for th Consumers Ice Co.

Natural Gas in Arkansas.—Dr. STEWART, of Fayetteville, Ark., has made a proposition to the City Counc to bore for natural gas if the Council will give him an exclusive franchise to pipe the streets with gas mains for 50 years. An ordinance has been prepared giving an exclusive franchise for 25 years and a concurrent franchise for the next 25 years. A company will be organized and work commenced within 6 months. If gas is found it is expected that smelting works will be established.

The Water Supply of Philadelphia, Pa.— A despatch from Hamburg, Pa., states that attention has been attracted to the Schuylkill river by reason of the black, murky condition of the water. The river is not much swollen, yet the water is of an inky appearance. It is supposed that the recent heavy rains in the coal regions have carried an unusually large amount of coal dirt into the stream, which may explain the discoloration.

The Siefert Rotary Pump Co. has been incorporated at San Francisco, Cal., to operate under the Siefert patents. The directors are OSWALD SIEFERT, JOHN FARNHAM, J. F. WENDELL, JAMES FINNEEN and WM. WENDELL. Capital stock, $2,000,000.

Louisville, Ky.—The Secretary of War has made a report refusing to allow sewers to empty into the canal. In 1884 the Kentucky Legislature adopted a joint resolution surrendering the canal to the U. S. Government forever. In 1882 the Legislature had adopted another joint resolution to the same effect. but giving Louisville the privilege of sewerage in it. Maj. STICKNEY, U. S. Engineer, at Louisville, refused to permit City Engineer SNOWDEN to open up sewers into the canal, and the matter was referred to the Secretary of War with the result stated.

The Rosario Drainage Co. has been incorporated in London to carry out sewerage and drainage works in the Argentine Republic. Capital, $4,000,000.

Denver, Col.—There has been much complaint lately about the city drainage ditches and the matter is being investigated. A measurement showed a flow of 1,056 ins. in the flume, while the contract is for 2,500 ins.; many of the ditches are nearly dry owing to the insufficient supply of water.

Portland, Me.—The Portland Gas Light Co. held its annual meeting recently. The consumption for the year was 49,467,000 ft., with 2,864 consumers. The average illuminating power is 18½ candles. During the year 538 ft. of 3-in. mains were laid and improvements made to the plant. The price is now $1.80 per 1,000 ft. President, E. H. DAVIES; Secretary, SAMUEL ROLFE.

Joliet, Ill.—The litigation over the water-works is finally settled, the city having accepted the award of the arbitrators, and will purchase the works for $186,620, paying $50,000 upon the resignation of the works to the city. The settlement gives general satisfaction.

Albany, N. Y.—The City Chamberlain sold at auction May 25, 350 4 per cent. Albany City water bonds, and the entire lot was purchased by Blake Bros. & Co., of New York, at a premium of $28,977, the largest premium ever paid in that city for 4 per cent. bonds. The last series of these bonds will mature in 1908.

Reservoir.—The Canal Commissioners held a meeting at Columbus, O., May 23, for the purpose of appraising the 6-mile reservoir in Paulding Co. The survey of the land has been completed and is ready to be placed on file. The commissioners have recommended the abandonment of the reservoir and that part of the Wabash Canal below the lock. There are about 20 000 acres of land embraced in the tract, with 720 in dispute, the Stambaugh heir, of Toledo, claiming to hold government patents on that number of acres.

San Francisco, Cal.—The Spring Valley Water Co. is at work on the pumping station between Redwood City and Belmont. At this point, the water which comes from Alameda county, and is conducted across and under the bay through the new pipe line recently laid, will be forced to an elevation of 250 ft. above tide level, and it will then flow through the pipes by gravitation and empty into the reservoir at San Francisco, 170 ft. above tide level, there being 180 ft. fall. The pumping works will be completed, the whole line laid and water flowing from Alameda county to San Francisco by August.

Rochester, N. Y.—At a recent meeting of the Chamber of Commerce the following resolution was adopted with regard to the proposed water power:

"*Resolved*, That it is the sense of this meeting that the Common Council be requested and urged to employ a competent corps of engineers to make a survey of the waters of the upper Genesee and its tributaries, and report a plan for storage of water for power that will supply our city with water during the summer months."—The Chamber of Commerce is also contemplating the introduction of natural gas.—The American District Steam Co., of Lockport, N. Y., has received permission to lay its pipes in Rochester, and will commence operations at once.

Atlantic City, N. J.—A writ of certiorari reviewing the proceedings of the City Council in granting to the Consumers' Water Co. an ordinance to lay pipes in Atlantic City was served upon THOMAS K. REED, President of the company, and Mayor I. D. HOFFMAN on May 18. The Atlantic City Water-Works Co., which has been supplying the city with water for the last 8 years, claims an exclusive privilege, and that the proceedings of Council were illegal. The certiorari will be argued in June. In the meanwhile the Consumers' Water Co. will be compelled to discontinue work.

Grand Junction, Col.—On May 18 the Council passed an ordinance granting to N. J. KRUSEN and his associates a water-works franchise for 21 years, the city to have the privilege of purchasing the works after 10 years. Work will be commenced shortly. The supply will be taken from the Gunnison river. There will be 2 pumps of 700,000 galls. daily capacity each, 2 boilers, a brick or stone engine house, and a stand-pipe not less than 20 ft. by 100 ft. The pipes will be cast-iron wrought-iron or steel, 4 to 10 ins. diameter. The test is to be 4 1-in. streams thrown to a height of 75 ft. The estimated cost of the works is $60,000. The city will rent 50 double discharge, non freezing hydrants.

Water Waste.—At Portland, Ore., attention has been called to the reckless waste of water, the rules of the water department being constantly violated and no attention paid to the remonstrances of the inspectors. It was at first proposed to shut off the supply from 10 P. M. to 4 A. M., but it was finally resolved that Superintendent SMITH should give notice that there was a great waste of water; that all persons found violating the rules would be cut off and subjected to extra expense; that the committee would use all diligence in detecting instances of violation and would act promptly in each case; and that the superintendent was authorized to use his own discretion in shutting off the water each night between 10 P. M. and 4 A. M. This, of course, will not be done unless the superintendent finds it impracticable to keep up the required supply in the reservoir with one pump. That will depend upon the dry weather and the demand for water.

The Bassett Circulating Hydrant Branch.—Bassett Bros., of Buffalo, N. Y., have received the following testimonial from JAMES LEITCH, Mayor of Cornwall, Ont., during the construction of the water-works.

DEAR SIRS:—Yours of the 19th inst. duly received, and would have been attended to at an earlier date, only that I was engaged in court. I made enquiry as to how the Bassett Circulating Hydrant Branch worked in this town during this winter, and have much pleasure in stating that notwithstanding the fact that this winter has been one of the most severe in Canada, the mercury at times going as low as 40 degrees below zero, none of the hydrants in the town have frozen. The hydrants have been tested every month, and during the most severe weather were always found to be free from frost. I have no doubt that this immunity from freezing is due to the water moving through the Hydrant Branch. I have noticed the water work's people flushing the hydrants several times, and the water when it starts is as clear as that flowing from an ordinary domestic tap.

JAMES LEITCH.

Glenwood Springs, Col.—The water-works are nearly completed and nearly all the pipe is laid in the town. The stone and brick power house will be completed in July. The water is taken from No Name creek 2¼ miles from the city. It is to be conveyed by a flume 8,200 ft., then by a pipe line for 6,000 ft. to the power-house. Here the new electric plant is to be located. The motive power for generating the electricity is to be water direct from the pipe line, which will have a pressure of 275 ft. of vertical height. From the power-house the water passes through a regulator to keep the pressure in the city mains uniform. All the above works are on the north side of Grand river while the town is on the south side. From the regulator a main crosses Grand river, being securely bedded in the bottom of the stream, and from this main the water is distributed throughout the town. Manager W. B. DEVEREUX of the Colorado Land Improvement Co., assisted by Engineer MASON W. MATHER, has this extensive undertaking in charge. The expenditure involved in the water-works and the new electric plant and power-house is $110,000.

Drainage Troubles at El Paso, Tex.—The old trouble about polluting the river with sewage has broken out again between El Paso and the people living below on the Rio Grande. El Paso some time ago built a complete system of sewerage under the supervision of engineer GEO. WARING, and the sewage is discharged into the Rio Grande, on which river 12 miles below, is the town of Ysleta. These people obtain all their water for drinking and irrigating purposes from the river, and they objected from the first to the sewage of El Paso being emptied into the Rio Grande above them. Litigation and arbitration followed, in all of which the Ysleta people had the best of it, and it was resolved that the El Paso people should build a new irrigating ditch for the use of the Ysleta people, with its mouth above the source of contamination. Although this was agreed to, the El Paso people never carried out their promise, and the Ysleta people became tired of the delay. A large number of them came up the valley recently and began the digging of a new canal. They had already finished quite a distance before the El Paso people found it out. Then a number of the leading citizens hurried down to the spot and pointed out that if the digging was persisted in and carried much further the river would, in its present high and turbulent stage, rush into the new opening and make it its new bed and thus throw a large section of country from the United States into Mexico. It was furthermore announced that unless work was stopped an injunction from a superior court would be obtained. A temporary cessation of the work then ensued and the matter will perhaps be amicably arranged.

Sewerage.—***Ware, Mass.***—A new system of sewers is proposed, for which bonds for $20,000 would be issued.

Waltham, Mass.—The Massachusetts Legislature has passed a bill authorizing the town to issue bonds for $100,000 for surface drainage.

Moravia, N. Y.—The Town Trustees are putting in sewers and drains.

Philadelphia, Pa.—The Committee on Surveys has adopted the report of a sub-committee on sewers, recommending an ordinance to authorize the expenditure of $340,000 for sewers. The amount available is $240,000 and $100,000 will have to be taken from the surplus of 1887.

Orlando, Fla.—Plans for a sewerage system are being prepared by C. K. NEEDHAM, C. E. The people have voted for the issue of $25,000 bonds.

Ottawa, Kan.—An appropriation of $30,000 has been made for the sewerage system, and the contract has been let to J. B. Jenkins & Co., of Fort Scott.

Helena, Mont.—The City Council has accepted the plans for a sewerage system which were presented by G. N. MILLER. A report accompanied the plans.

Artesian Wells.—***Asbury Park, N. J.***—Another well has been put down and struck a good flow of water at 554 ft. This is the fourth additional well.

Hilton, N. C.—The artesian well is now down to a depth of about 350 ft.

Davisboro, Ga.—Another artesian well has been put down for T. L. BROWN by contractor Clay.

Bellevue, O.—A good flow of water has been struck at a depth of 185 ft. and for six days a steam engine pumped 8,650 barrels per day.

Pittsfield, Ill.—A good supply of water has been struck at a depth of 1,000 ft., and the contractor has been ordered to continue drilling.

Jerseyville, Ill.—The artesian well has struck a flow of water at a depth of 1,648 ft.

Ipava, Ill.—The artesian well has been finished and the drilling stopped at a depth of 1,570 ft., the water standing within 16 ft. of the top. The well was tubed down to the Trenton limestone and then tested for 12 hours with a steam pump, which threw 60 galls. per minute. The supply is considered to be ample. W. B. Decker was the contractor.

Mount Sterling, Ill.—An artesian well is to be put down by W. B. Decker.

Benson, Minn.—The village council have entered into a contract with a well-boring firm to sink an artesian well 1,000 ft. deep.

Richfield, Kan.—An artesian well is to be put down, and the plant has been delivered.

Longmont, Col.—An artesian well is to be put down 500 or 600 ft. and is already over 300 ft. deep, with some water flowing.

Medford, Ore.—Artesian wells are proposed to furnish a water supply. Experiments are to be made.

Water-Works.—***Vermont.***—Northfield. A committee has been appointed to consider the question of water-works. Address W. B. MAYO.

New Hampshire.—Dover. The Cocheco Aqueduct Association has been awarded $67,000 for the works by the Commissioners.

Connecticut.—Williamstown. The Williams Aqueduct Co. has purchased a site for a reservoir.—Windsor Locks. The Windsor Locks Water-Works Co. received a proposition last Saturday from Goodhue & Birnie, of Springfield, Mass. The firm proposed first to do the job for $40,000 and $1,000 extra from the town for laying pipes for fire purposes; also it was proposed to bring the water from the reservoir at Thompsonville, down Enfield St., thus getting a greater head than from any other source. No action was taken on the proposition and the meeting adjourned until other proposals had been received.

Massachusetts.—Boston. The Water Board will spend about $100,000 for extending the new mains for the Cochituate water-works, and $35,000 for improving Lake Cochituate.—Martha's Vineyard. A water system is proposed, the supply to be obtained from a spring 2 miles distant, and not from Vineyard Haven as was first proposed.—Shelburne Falls. The Coville Aqueduct Co. has re-elected the old officers and will put in a new hydrant.

New York.—Geneva. The Fall Brook Co., believing the water of Keuka lake to be injurious to its engines, intends to remove its pumping station to Angus and use the water of Seneca lake.

Kentucky.—Nicholasville. Water-works are projected.—Mt. Sterling. Water-works will probably be built.

South Carolina.—Seneca. A system of water supply is to be established.

Georgia.—Crawford. Water-works are projected.

Alabama.—Troy. J. W. BATES has a franchise for water-works. The supply will be obtained from artesian wells.

Michigan.—Caro. The water-works are being pushed to completion; the pipe is being laid.

Illinois.—Belleville. The new reservoir has been completed and the water let in.—Lewistown. The water-works are under construction. The pumps and driven wells will be 3 miles from the city, on the banks of Spoon river.—Pinckneyville. The City Council will take steps very shortly to put in water-works.

Montana.—Assinaboine City. Helena parties are talking of putting in water-works.

Oregon.—Medford. A proposition has been made to bond the city for $5,000 for water-works. An offer to bring a supply of water to the town has been made by J. E. DRUCK.

Texas.—Beaumont. Water-works have been built by the city and leased to a company. The contractors were Thomas & Gorman.

California.—Sacramento. New pipes are to be laid.—Los Angeles. The water-works have been sold to C. A. THORN and F. F. LOW, for $300,000.—Oakland. A reservoir is to be built with a capacity of 25,000 galls. Estimated cost, $5,000. W. W. GOODRICH, engineer.—Salinas City. P. A. Taylor has applied for a franchise for water-works.

Vancouver, B. C.—The Vancouver Water-Works Co. has completed its new dam on the Capilano river 6½ miles from its mouth, the low water level being 406 ft. above tide level. The dam is built of timber cribs filled with boulders, coarse gravel being filled in to make the mass solid. The water is led through conduits, provided with wire screens, to the wells at the mouth of the double line of 22-in. steel pipe. The extreme length of the dam is 385 ft., 41 ft. wide. Work was commenced in January and completed in April, at a cost of about $15,000. The city will soon have a first class water supply.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water-supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

FRANKLIN, Mass., May 22, 1888.

EDITOR ENGINEERING NEWS:—We are just completing a tank 80 ft. long by 30 ft. built of ⅝-in. iron. It is to take the place of the one which we lost last October, and stands on the same solid rock foundation. We are also putting in a new boiler.

W. E. MASON, *Supt. Franklin Water Co.*

MANCHESTER, Va., May 25, 1888.

EDITOR ENGINEERING NEWS:—New works are to be constructed by WM. H. WHITE & BRO., 82 Pine St., New York. The principal features of the ordinance under which the contract was made are: The water is to be taken from the James river above Canoe Run. The pumping engines are to supply 1,500,000 galls. in 24 hours, with provision for increase, and must be as good as the Worthington or Blake pumps. The pipe for mains is to be of cast-iron, tested to 300 lbs. pressure, and none to be less than 4 ins. in diameter. Pipe to be buried 4 ft. below surface. There are to be 5 miles of distributing mains, besides the pipe from pump to tower and thence to city. There will be 50 double nozzle fire hydrants of approved pattern, tested through 250 ft. 2½-in. hose with ¾ in. nozzles. Work to begin within three months and to be completed within fifteen months. The rates charged consumers must not exceed those charged in Richmond, and the works shall be exempt from city taxation for 10 years. Provision is made for the purchase of the works by the city. Work was begun upon the pump house last week.

F. P. LEAVENWORTH, *City Engineer.*

LEBANON, Ky., May 21, 1888.

EDITOR ENGINEERING NEWS:—The village proposes to issue bonds to put in water-works at a cost of $50,000. Our population is 3,000 and is now supplied with water from wells and cisterns. The proposed supply is a small stream four miles from the village. The system will be pumping to a reservoir. The Lebanon Water Co. has been organized with ANDREW OFFUTT as President. No surveys have yet been made although it is proposed to let contracts in about two months.

J. M. KNOTT.

LEMONT, Ill., May 18, 1888.

EDITOR ENGINEERING NEWS:—We will build another reservoir this summer the same size as our present one, 20 by 40 ft. and 14 ft. deep. It will have an elevation of 160 ft., and require two miles more of main pipe.

D. C. NORTON, *President of Village.*

PIALTO, San Bernardino Co., Cal., May 18, 1888.

EDITOR ENGINEERING NEWS:—We began the construction of water-works for this place July, 1887, and will finish the works in June of the present year. The supply is taken from Lytle creek, at the mouth of Lytle Creek canon, in the Sierra Madre mountains and brought by gravity to the town, 1050 ft. below and 9¾ miles distant.

We start from the crib in the canon with a covered red wood flume 700 ft. in length, which empties into a spacious sand-box. The conduit continuing thence 5 miles with an open ditch, rock-walled and cemented, having a total fall of 688 ft. This discharges into another sand-box or filter basin, before entering cement-concrete pipes which convey the water 2½ miles farther, and discharge it into a storage and service reservoir, proposed to be built, or rather commenced, this Fall. At present we connect directly with cast and wrought-iron mains for the remaining distance of two miles.

We are laying approximately 112 tons (2000 lbs.) of cast iron pipe and 170 tons of standard wrought-iron screw pipe, not including special castings and fittings. All pipe is specified to withstand pressure of 300 lbs. per sq. in.

The open cement ditch was designed to convey 26,000,000 galls. a day, for town and irrigating purposes, and also to meet the demands of a storage reservoir to be filled during the "rainy season". Our engineer estimates that it will easily carry one-third additional. The town system will furnish 1,200,000 galls. every 24 hours.

The contract price for cement ditch was $31,000. We have paid about $3,500 additional for extra work. Mr. J. B. Frith, contractor. The contract price for cement concrete pipe ranging from 10 to 24 ins. internal diameter was: For town system $13,500, for irrigating system, which must be periodically extended, $29,500; making a total of $43,000. Mr. N. W. Stowell, cement pipe manufacturer of Los Angeles, Cal., was the contractor. The cost of the iron pipe system will be approximately, $18,000. Pipe furnished by Crane Bros. Manufacturing Co.

Mr. Burr Bassell, civil engineer of Los Angeles, Cal., has designed and superintended the construction of the works.

The present organization, known as The Semi-Tropic Land & Water Co., owns most of the water and about 30,000 acres of land adjacent to the town.

When we get our storage and service reservoir constructed, we think we will have an excellent water system, supplying the best of mountain water for domestic use. Our town is a suburban residence section of San Bernardino, the county seat, and while it is true that our present population is small, our water system which would reflect credit on a much larger place, does not merely exist on paper as many California "systems" do.

J. W. TIBBOTS, *President.*
M. V. SWEESY, *Secretary.*

Annual Reports.

Milwaukee, Wis.—The Board of Public Works has issued its report for 1887, including the reports of the City Engineer, and other officers. During the year the water system was increased by about 13.739 miles of 6 to 24 in. pipe and 96 hydrants. There are now 147.449 miles of pipe and 1207 hydrants. There were 9.10 miles of new sewers built and there are now 146.333 miles of brick, cement pipe and iron sewers. The tunnel from Lake Michigan to the Milwaukee river, for flushing the river, is expected to be completed this summer; it will be 12 ft. inside diameter and 2500 ft. long. The contract is let to Wm. Forrestal at $47.25 per lin. ft. and the pumping machinery will be furnished by E. P. Allis & Co. at $37,500. An iron swing bridge, with stone center pier and abutments, has been built over the Milwaukee river at Pleasant St., at a total cost of $32,697 Dredging has been done by C. H. Starke at 17, 14 and 13½ cts. per cu. yd. in the Milwaukee, Menomonee and Kinnickinnic rivers respectively. An important feature of the report is the series of tables of work done, with prices and amounts, and list of contract prices. At the North Point pumping station of the water-works it has again been demonstrated that the use of steam is the only safe preventive against the choking up of the intake by anchor ice. Results of the test of the 6,000,000 galls. high service pumping engine are given. A large amount of street work has been done. At the special sewerage works the machinery pumped 13,900,666,500 galls. of sewage and river water into the lake. The total amount of water pumped by the three water-works engines was 7,333,490,248 galls. The report forms a book of 358 pages, and is accompanied by diagrams of water consumption and a large map, of the sewerage system G. H. BENZENBERG is City Engineer and President of the Board of Public Works. JOHN HATHAWAY is Assistant City Engineer.

Hyde Park, Ill.—The President and village officers have issued their reports for the year ending April 1, 1888. During the year 17½ miles of water pipe have been laid and water supplied to 1159 new consumers. The village has now 87½ miles of paved streets, 40¼ miles of sewers 95 miles of 4 to 24-in. water pipe, 155 miles of wood sidewalks, 8¼ miles of stone side-walks, 991 gas lamps and 755 gasoline lamps. The Chicago City R. R. Co. has extended its cable lines through the village, and an elevated railroad connection is expected to materialize at an early date. The total amount of water pumped was 2,452,722,535 galls. at a total cost of $15,100.88. The fuel used at the water-works is Indiana block coal, costing $2.73 per ton and having an evaporative strength of 7 lbs. of water per 1 lb. of coal. There are 75 Worthington meters. The death rate for the year was 11.75 per 1000. The litigation over the proposed annexation to Chicago, which was desired by that city, is described; the Supreme Court decided that the city's proceedings were unconstitutional. The reports are accompanied by 3 maps. A. V. POWELL, C. E., is Superintendent of Public Works.

Holyoke, Mass.—The Board of Water Commissioners have issued their report for 1887. The year has been a prosperous one and the supply of water has been excellent in quality and quantity. A storage reservoir on Whiting Street brook is recommended; the watershed has an area of 857 acres and the flowage area would be 114 acres; the estimated cost of a stone dam, 23 ft. high and 1,850 ft. long, is about $50,000. During the year 12,777 ft. of pipe were laid, 32 gates and 13 hydrants set. There are 49 miles 2,063 ft. of 4 to 20-in. wrought and cast-iron pipe, 274 hydrants, 298 gates, and 149 meters. The works were built in 1873 and are owned by the city; the supply is by gravity from 2 contiguous natural lakes and 2 mountain streams. Range of pressure 45 to 65 lbs. at office, 80 to 100 lbs. on Main St. The services are of cement, rubber lined, enameled and cast-iron pipe. The population supplied is 30,640 and the total consumption of the year was 820,017,368 galls. JOHN D. HARDY is Superintendent.

Winthrop, Me.—The Town Officers have issued their reports for the year ending March 12, 1888. In accordance with the vote of the town, passed in March, 1887, the Board of Selectmen have raised by loan $300 and have expended of that amount sufficient to lay about 375 ft. of new pipe and have erected one new hydrant. The water-works were tested May 14 and July 2 by the Chief Engineer and found in good condition. CHARLES A. WING is Chief Engineer of the Fire Department.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

(CONTINUED FROM PAGE 438).

Texarkana, Ark.—The works were commenced in June, 1887, and completed Sept., 1887. The engineer was L. METESSER, of New Orleans, who also supplied the machinery. The contract for masonry and foudations was taken by Varner Bros., of Texarkana; for buildings, A. M. Hawkins, of Texarkana. The trenching and pipe laying were done by the company. Chapman valves and hydrants are used. The supply is pumped from 10 artesian wells to a lake with a capacity of 3,000,000 galls. There are Gordon & Maxwell pumps with a daily capacity of 2,500,000 galls., and Heine safety boilers. There are 4½ miles of mains, 28 hydrants, 110 taps and 1 meter; the mains are of cast-iron, and the service pipes of lead and wrought-iron. Average daily consumption, 600,000 galls. Ordinary pressure, 80 lbs.; fire pressure, 130 lbs. Cost of works, $64,000; debt, $60,000; rate of interest, 6 per cent. Annual expense, $8,000; annual revenue from city and consumers, $11,400. The works are owned by the Texarkana Water Co. President, J. A. POLHAMIUS; Secretary, T. M. POLHAMIUS; Superintendent, E. N. MAXWELL. The company has $60,000 stock, $60,000 bonds. The franchise is for 30 years; hydrant rental, $100 per hydrant per annum for the first 20, and $75 for all beyond that number. The present population is 10,000.

Helena, Mont.—The works were commenced in June, 1887, and completed in May, 1888. They were designed by R. R. CLARKE and GEO. E. EVANS, and the latter was also Constructing Engineer. The contractors were, for masonry, foundations, buildings, trenching, pipe-laying and reservoir, Geo. F. Woolston, New York; for pumping machinery, Geo. F. Blake Mfg. Co., New York; for pipe and specials, National Tube Works Co., Pittsburg, Pa.; for valves and hydrants, Chapman Valve Co., Indian Orchard, Mass. The supply is taken from a shallow well reinforced by 6 artesian wells, and the water is pumped to a reservoir with a capacity of 2,500,000 galls. by 2 compound engines of 2,800,000 galls. daily capacity, with 2 return tubular boilers. There are 15 miles of pipes and 150 hydrants; 700 applications for taps have been received and services are now being laid. The mains are of Kalamein pipe and the service pipes of galvanized iron. The average pressure is 75 lbs. The works are owned by the Helena Water Co.; President, B. S. AMBLER; Treasurer, A. B. TURNER; Superintendent, A. R. GATES. Capital stock, $300,000. The franchise is for 20 years and the annual rental $100 per hydrant. The present population is 13,000.

Kinsley, Kan.—The works were commenced Sept. 1, 1887, and completed in April, 1888. They were designed by J. W. NIER, of Kansas City, Mo., and S. JOBE, of Carthage, Mo., was Constructing Engineer. The contract for construction was let to D. Mitchell & Co.; of Dodge City, Kan., and the cost was as follows: masonry and foundations, $1,500; buildings, $2,000; pumping machinery, $5,800; pipe and specials, $11,500; trenching and pipe laying, $1.65, $1.25, 90 cts. and 60 cts. per ft. for 10, 8, 6 and 4-in. pipe; stand-pipe, $725. The supply is drawn from a well and pumped to a stand-pipe 16 ft. × 120 ft. The pumping machinery consists of a Dean compound duplex pump of 1,500,000 galls. daily capacity, with tubular boilers. There are 5 miles of pipe, and 25 hydrants; the mains are of cast-iron and the service pipes of wrought-iron. Ordinary and fire pressure, 65 lbs. Cost of works, $40,000; debt, $40,000; rate of interest, 6 per cent. The works are owned by the city, which has issued bonds for $40,000. The present population is 3,300. S. JOBE, Superintendent.